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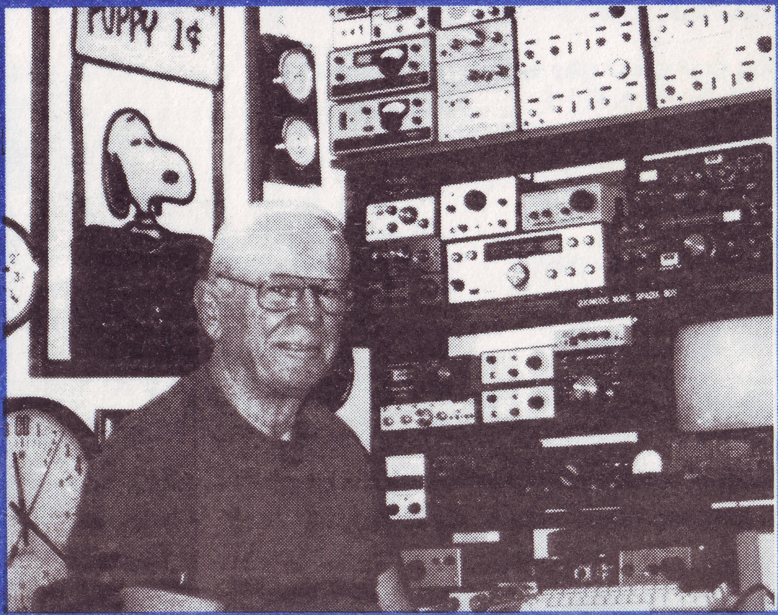

Jim Cates, WA6GER
"A Gentleman"

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From the Editor

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You will have noticed that Jim Cates, WA6GER, has his picture on the front of this issue. This is the first "Cover Picture" that I have done. I did it to honor a man who is my best friend, and is a friend to QRPers all over the world. He works many hours daily for QRPp, and I wanted to show my appreciation. The cover says, "Jim Cates, WA6GER, A Gentleman", and for all of us that know Jim personally, that describes him perfectly.

We have had an exciting fall in the QRP world. The Cascade has been born, and from the first reports is an outstanding success. John Liebenrood, K7RO and Dave Meacham W6EMD are to be congratulated for their design of a great kit. There have been many requests for more of the Cascades and I am pleased to announce that we have 50 more kits available. They will cost $199 each as we only kitted 50 this time and parts have gone up. If you are interested, see the announcement on page 66. Act fast, because when those 50 Cascades are gone, there will not be any more. John has decided to move on to other projects and he is not interesed in making the Cascade a commercial venture. If you want one, order fast.

We are announcing that we are now taking orders for the St. Louis Tuner. This tuner is a cooperative venture between the St. Louis QRP Club and NorCal. See page 66 for ordering information. We will kit 250 of these and they will go fast. This is the first announcement and we did it in QRPp because we want to give the first chance to our members. Note that the variable capacitors are now custom air variables and not the plastic am radio ones.

The Cascade construction article by John is printed because we realized that even though 200 club members bought the kit, over 1200 did not, and they have not had the opportunity to see the design. I felt that the rest of the club deserved to see John's work. IT is and was an outstanding effort.

NorCal and ARCI had a booth at Pacificon again this past October, and it was a chance for many of the NorCal members to get to meet each other and have that eyeball QSO that we seem to need.

Jim and I decided last spring that one of the best ways that we could put club money to use was to sponsor the speakers for the QRP Forums. We contacted Dick Brown of Pacificon, and he agreed to give us the large lecture room if we would agree to supply "World Class Speakers". We did that by having John Liebenrood, K7RO the designer of the Cascade, Derry Spittle, VE7QK, the designer of the Epiphyte, speak on SSB on Saturday. And then we came back with Wayne Burdick, N6KR, the designer of the NorCal 40, Sierra, and KC1 and Stan Goldstein, N6ULU, who has worked 113 countries with his NorCal 40 to speak on CW.

All four of the speakers were outstanding, and were presented NorCal Pacificon QRP Forum Plaques as a token of NorCal's appreciation for their efforts. Stan Goldstein was also presented a plaque for being the first to reach DXCC with the NorCal 40. (We are only going to give 1 plaque, and Stan has won it!)

Jim and I both feel that this is an excellent project for NorCal, and we plan on it again next year. We are even thinking of sponsoring a full day of QRP forums, sort of a West Coast QRP Symposium, with speakers from the BC QRP Club, NW QRP Club, the Arizona QRP Group, and the Southern Cal QRP guys. It would be held in conjunction with Pacificon, and NorCal would rent a room for forums during the day and then have a hospitality room "a la Dayton" in the same room at night. Let Jim know what you think of the idea.

Jim Cates, WA6GER, "A Gentleman"

I asked Mac to write this biographical sketch because he is one of Jim's oldest and dearest friends. He knows the early history of Jim Cates and his ham radio career as well as anyone.

This issue is dedicated to the best friend that I have ever had. He has been a friend in every way. Jim is always the level headed one of the two of us. He is the one who keeps me under control and the one who prevents most of the mistakes that I would make in a rush of anger.

Jim Cates embodies the spirit of NorCal and of QRP. He is quiet, unassuming, gentle and the most giving person I have ever known. He spends countless hours working behind the scenes to make sure that NorCal QRP Club and all of our projects stay on course.

Jim is the first to have his Picture on the cover of QRPp. I don't know if anyone else ever will. This article was written and this issue is dedicated to Jim Cates, WA6GER without his knowledge. Hopefully he will like it. Doug, KI6DS

Laissez Faire Exemplified

by D.J. "Mac" MacDonald
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No, I'm not talking about laziness. Though I have been told I personify it and that is just because I have spent a large part of my life studying it first hand. What I am talking about is the principle of minimum authority whether of government or in this case club organization and operation.

NorCal members and readers of the QRPp journal might be interested in a brief status report on the club and a short biography of one of its two founding fathers, Jim Cates, WA6GER. His concept of *Laissez Faire* and its implementation in the organization and operation of an amateur radio club.

NorCal QRP was conceived by Jim Cates, WA6GER and Doug Hendricks, KI6DS. They thought that they might be able to find 15 or 20 hams who were low power fans to form a club. Jim, having spent 33 years in government and knowing full well its faults and weaknesses wanted nothing more to do with rules, regulations, charters, by-laws or what have you. In addition, being born in Texas he was (and is) a natural born rebel; though he denies that his bed sheets are in the pattern of the Confederate flag. Doug, KI6DS, our editor, being a Kansas Jayhawker, (you remember them from your US history) is of the same ilk. I could have said mindset, but those of you who know Jim and Doug undoubtedly recognize the accuracy and veracity of the above.

This club, they said, would have no constitution, no charter, no by-laws, no officers, no dues, no business reports or formal meetings and no minutes. Each member is equal to every other member. Therefore any member can do what he or she wants. Though there are no dues, there is a subscription fee if a member wants to receive the quarterly publication.

So what has happend? From the 15 or 20 hams initially expected, the club now has over 1450 members in 48 states and 31 countries with members on every continent except Antarctica. We have members from Spain to Siberia, China and to Malaysia, Australia and Oceania, Alaska to Argentina. Could it be that the principle of *Laissez Faire* as practiced by our club has struck a responsive chord world-wide? The other possibility is that we may be a club of 1450 Rebels and Jayhawkers. Naw, that couldn't be, because hams by nature are very submissive and would never think of a different way of doing things from the tried blue, cast in concrete, already proven concepts.

So who are these guys, Jim and Doug,

who have shepherded NorCal QRP Club to its current prominence in the world of QRP? This is a short biography of Jim. Doug's will follow at a later date.

Jim Cates, WA6GER, born in Lufkin, Texas, was the second of three sons born to Charles and Lottye Cates. Born in 1926, he was educated in the public schools of Texas graduating from high school in 1942, four days past his sixteenth birthday. He joined the U.S. Navy in 1943 and after attending a Navy school was assigned to the Alameda Naval Air Base, Oakland, California as an Aviation Ordinanceman. While stationed there, he met Electra in 1944 and married her in September of 1945. Two sons, Steve, KC6TEV, NorCal Awards Chairman, and Jack, ex-WB6OEP, were born of this union. And this year Jim and Electra celebrated their 50th wedding anniversary.

Upon discharge from the Navy in April of 1946, Jim entered the University of California, Berkeley. Three years later, 1949, he graduated with a degree in Journalism andproceeded to go to work in Modesto, California as a Probation Officer. One year later he and Electra returned to Oakland, California to work for the Alameda County Probation Department (higher pay). Then, in August of 1953, Jim joined the California Adult Parole Division in Sacramento, California.

As a Parole Officer Jim: carried a caseload of adult felons; was Assistant Supervisor and later Supervisor of the Sacramento District Office; Assistant Supervisor of the Interstate Unit, responsible for arranging the supervision of all California parolees paroled out of state and, when necessary, their extradition. He was also Interim Regional Administrator for the area from the southern Oregon border to the northern Los Angeles county line, from the east side of the Coast Range Mountains to the Nevada state line. Through Jim, and his most able assistant, modesty forbids my mentioning his name, Region I set a standard of excellence that to this day has not been equaled in the parole division.

In 1959, inspired by lunch time conversation between Bob, ex-K6SDH and K6AGN, both Parole Officers, Jim became WV6GER. Motivating one to be all one can be (a phrase I am sure the Army copied) was carried to the nth degree when Jim became enamored with ham radio and electronics.

After his first CW contact on the Knight Receiver he built there was no stopping him. He built kits, modified surplus Air Force gear (MARS) and home-brewed. He is a CW aficionado, has owned and operated AM, FM, SSB, 2 meter, 6 meter, 220, 440, 1296, RTTY, ATV, and packet gear. The only thing he hasn't done as far as I know, is moon bounce and he is looking into that. I might add that as expected, he has WAS, WAC, DXCC, and has won a number of Field Day Contests. His true love and burning passion though is QRP. As proof thereof, take a look at the operating position of his ham shack.

I feel that I would be remiss if I failed to touch on his finest quality, helping others. The Greek philosopher, Sophocles, wrote, "It is but sorrow to be wise when wisdom profits nothing". After choosing and spending a career of 33 years helping others he switched "clientele" and became an ELMER to multiple others repairing sick rigs, teaching code, helping raise antennae, and much,much more. Personally I doubt if he has ever given much thought to it but his own philosophy and guiding principle has to be, "Help where help is needed".

So there you have it, a brief sketch of a very talented guy, one who after spending a career in public service continues to use his time and talents in ways that enrich the lives of others. Many of us who know Jim have been and continue to be the beneficiaries of his sensitivity, thoughtfulness and helping hand. CU K6AGN es 73

The Cascade: A 20/75M SSB Transceiver

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I have always wanted to design a SSB Transceiver, but have not done so due to time constraints and lack of encouragement. My strength is in circuit design, but packaging is one of my weaknesses. In the fall of 1994, I posted a description of the R2/T2 design by Rick Campbell that I had built on the QRP-L list on the internet. Doug Hendricks contacted me and encouraged me to write a full fledged article for QRPp. I did so and the article was published in QRPp and later in Sprat.

Doug and I made a trip to Vancouver, British Columbia to meet the members of the BC QRP club who have been experimenting with SSB QRP rigs for over 10 years. We met Derry Spittle, VE7QK, Bruce Gellatly, VE7ZM, and Joe Stipek, VE7TX and others who are heavily involved in the design and operation of SSB QRP rigs. The trip inspired me. I picked up a lot of tips from Joe, Bruce and Derry, and I on the way home I asked Doug if NorCal would be interested in a SSB club project. I would design the rig, but would need help with the packaging and the writing of the manual. Doug had brought along a Sierra, which was the second NorCal club project and is an absolute work of art in its packaging design. We discussed the possibility of a SSB rig of my design in a Sierra style case. Doug said that he would have to talk it over with Jim Cates, WA6GER, the cofounder of NorCal, but he didn't think it would be a problem.

The next evening Doug called with good news. Jim thought the idea had a lot of merit, and there had been a lot of requests for a SSB rig. They gave the go ahead on the condition that the following conditions would be met.

1. The rig had to meet NorCal standards.
2. I would have to build a working prototype deadbug style.
3. NorCal would pay for all research and development costs.
4. NorCal would have one of their design people go over and evaluate the design.
5. It had to be a circuit board designed project that used a gerber file.
6. The prototype had to be finished by Dayton.

I went to work and started the design process. The following is the result of hundreds of hours of work, but was also a labor of love.

The first thing that you should do when you decide to produce a kit or club project is set paramaters. Doug and I set the following goals for the Cascade:

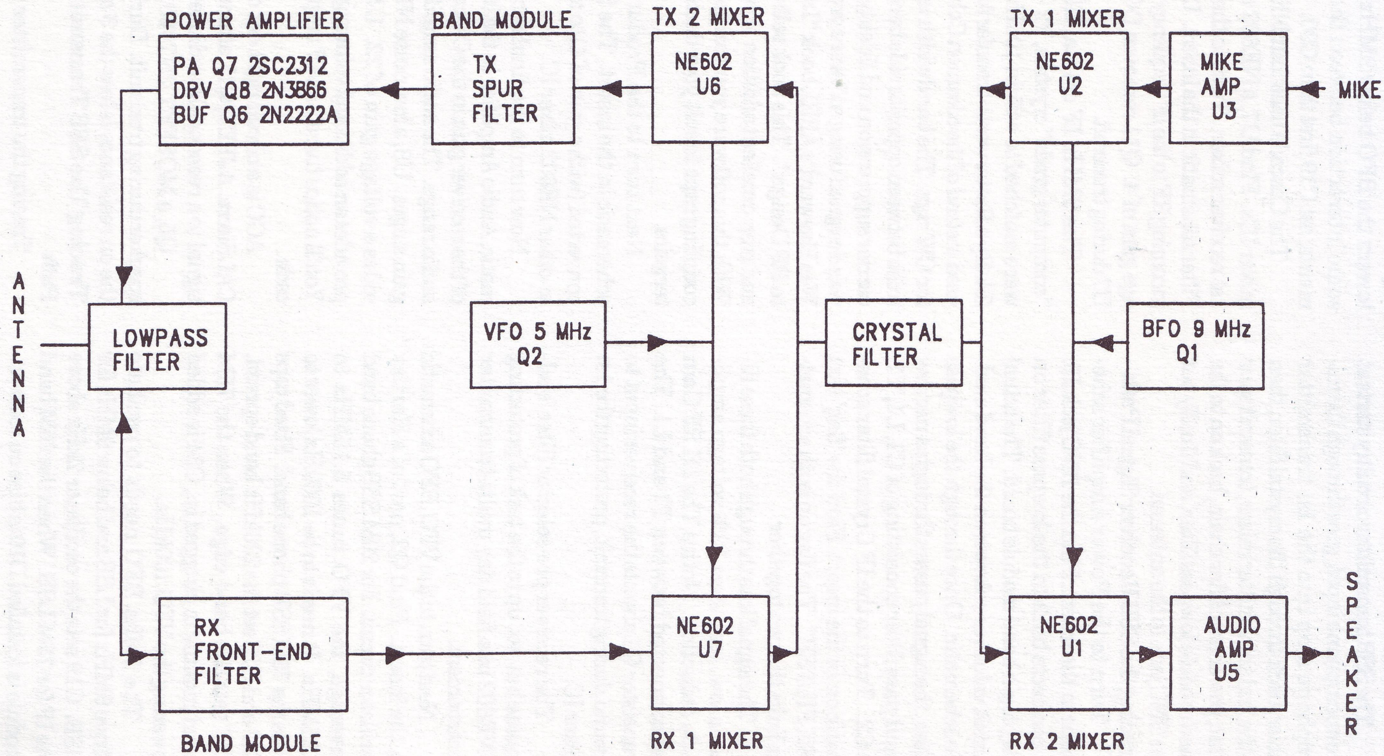
1. Simple to build.
2. Stable, VFO controlled, 200 kHz coverage.
3. Small in size, easily adapted to portable operation or bike hiking.
4. NorCal type packaging (No wires to connectors, easily accessible case.)
5. Inexpensive (Less than $200 for complete kit.)
6. Dual Band Coverage 20/75 Meters. 20 Meters for daytime use, 75 Meters for night.
7. Homebrew SSB filter using common, cheap, easily obtainable computer crystals.
8. Meet FCC specifications for spectral purity.

Circuit Description

A valuable technique in RF trouble shooting is tracing the signal path. We'll trace both the transmitter and receiver signal paths separately. This section will also try to clear up how all the schematics link together.

As a starting point, look over the Cascade Block diagram on page 4. The receiver circuitry starts at the BNC antenna jack, goes through the low pass filter on the band module card, into the receiver pre-selector filter, back on to the main board to the 1st receiver mixer, through the crystal filter, then the product detector and finally to the

CASCADE: K7RO QRP SSB TRANSCEIVER BLOCK DIAGRAM



audio amplifier.

The SSB transmitter circuitry starts at the microphone input, goes through the microphone amp into the 1st transmitter mixer, back through the crystal filter, then to the 2nd transmitter mixer, transmit spur filter, power amplifier chain, back on to the band module lowpass filter, and finally out the BNC jack to the antenna.

Tracing the SSB Receiver Signal Path

Turn to the Power Amplifier schematic in the insert. Find the BNC jack J5. It connects back to the lowpass filter on the plugin band module board. The actual circuit values are shown on the band module schematic. Once through the lowpass filter, the signal passes through a narrow band pass filter consisting of C1, L1, T1, & C2. Turn to the IF Crystal filter schematic on in the insert. Find the 'flag' text "RX FILTER". The flag on both schematics links the two together.

The signal loss through both these filter is low, less than 12% voltage amplitude reduction. Notice The 1K RF Gain pot connected between T1 and L1. The transistor Q1 shunts the receiver input to ground during transmit, protecting the 1st mixer IC.

The receiver pre-selector filter is adequate but not up to the task of protecting a NE602 in a field day multi-transmitter environment.

Next turn to the VFO, BFO schematic in the insert. Find Q2, part of a Hartley oscillator circuit. For 20M SSB phone band coverage, the VFO tunes 5.15MHz to 5.35MHz. It needs to be 100kHz lower to tune the 75M SSB phone band. Fixed caps C22 and C25 set the 200kHz band-spread, C17 sets the band edge. When the 75M band module is plugged in, C34 is added lowering the VFO 100kHz.

The 9Mhz BFO needs to oscillate above 9MHz for LSB and below 9MHz for USB. C19 sets the oscillator 2kHz above the IF for 75M LSB. When the 20M band module is installed D10 is bias on connecting C90 across C19. The addition of C90 lowers the BFO below 9MHz. There is some interaction between these adjustments, set C19 first then C90.

The Cascade uses four NE602 active mixer ICs. Find U7, a NE602 used as the 1st receiver mixer. Turn to the IF Crystal Filter schematic in the insert. U7 converts incoming RF to the IF frequency with a voltage gain of 4. Q11 removes DC supply to U7 during transmit.

The 9MHz IF crystal filter uses 5 "computer grade" crystals, Y2 - Y6. These were matched to within 100Hz. For SSB fidelity a Butterworth transfer function was used instead of the common Cohn response for CW rigs. The bandwidth is a compromise between opposite side band rejection, carrier suppression and fidelity. The filter was designed using software provided with Wes Hayward's ARRL book "Introduction to RF Design". This book sells for $29.95 and is an excellent addition to your library. With this software you can redesign the coupling caps to suit your desired characteristics.

Next turn to the Product Detector schematic in the insert. The 9MHz IF is converted (with a gain of 4) to audio in U1, another NE602 mixer IC.

Now turn to the final receiver schematic, Audio Amplifier in the insert. Most of the receiver gain in the Cascade is at the audio range. The audio amplifier has two gain stages. U8, a low noise NE5532, provides a voltage gain of 22. U5, a LM383 provides an additional voltage gain of 1000. You'll notice there's no IF amp in the Cascade.

AGC is a circuit right out of the NORCAL Sierra. A JFET, Q17, attenuates S9++ signal to a reasonable audio level.

Q5, a MOSFET 2N7000, mutes the speaker during transmit. During receive, the on resistance is less the 3 ohms.

Tracing The SSB Transmitter Signal Path

Tracing the transmitter signal path

starts at the microphone input jack. Turn to the Product Detector schematic on page 19. Find J1, the front panel microphone jack. The radio accepts a "Icom standard" electret microphone circuit. These microphones have the PTT switch and microphone in series, the PTT switch completes the circuit to the ground terminal.

Q3 provide the 2V microphone bias and switches the 8VTX line during transmit. U3 provides a one chip speech processor. The chip samples the microphone audio and adjusts the gain to hold its output at pin 8 at a constant 100mV RMS.

More than 20dB of speech compression is possible. R4 sets the amount of compression. R4 is set at 1K, I set the compression at a moderate level, you may want to experiment with different settings. R1 and C86 set the attack and decay times. You may want to tweak the values for some more audio punch.

Next the signal passes into Q15. Q15 mutes the transmitted audio during receive. R63 is a fixed resistor, this is a good place to adjust the microphone gain. 4.7K is about right to drive the NE602. It is easy to over-drive the NE602 active mixer IC and end up with lots of out-of-band spurs.

U2, the third NE602, generates the double side band signal at 9MHz. Carrier balance would be improved if U3 pin 5 and 4 drove a balanced transformer into the crystal filter. For now it is a single ended drive, yielding 30dB of carrier balance.

Q14 disables the transmitter mixer during receive, this stops hiss from showing up in the audio due to the TX mixer.

The double side band RF next passes back through the IF crystal filter. Turn to the IF Crystal Filter schematic on page 20. The SSB filter removes the opposite side band and suppresses the carrier. U6, the final NE602 mixer IC, translates the 9MHz RF to the final transmit frequency with a voltage gain of 4.

The output of U6 pin 5 goes to the unity gain JFET buffer. The drives the 50 ohm terminated transmit spur filter. The transmit spur filter is on the band module card, refer to the band module schematic for circuit values.

Now turn to the final transmitter schematic, Power Amplifier in the insert. The transmit spur filter is represented in the bottom right corner. The filter is driven with baluns to improve spur rejection due to signal leakage around the band module card. Both transmit filters have low signal loss when properly adjusted. Both filters match into 50 ohm terminations. Once through the appropriate filter, the low level SSB signal is amplified in 3 gain stages. The first two stages are biased for Class A operation. This takes a fair amount of idle current. The final power amplifier transistor is biased for AB operation. With no signal the 2SC2313 should draw 200mA.

D12 maintains a constant bias current as the final heats up with use. D12, which is in physical contact with the case of Q7, temperature compensates the bias network. The 2SC2312 needs a low value emitter resistor to stabilize the bias network. This did reduce the power out some. A compromise was made to help keep the Cascade cost low. A low cost 2SC2312 was selected. For those wanting more output a MRF477 can boost the power out for an extra $18. RF Parts sells these via mail order.

The SSB signal next goes back to the band module board where the lowpass filter is located. The 75M lowpass filter has two extra caps, C13 & C14. These add a deep notch at the second harmonic of 3.8MHz, to attenuate the highest spur.

That is it, now you should have an understanding of the way that the Cascade works.

Cascade Specifications and Goals

Size: 2.6"(H) by 6.3"(W) by 5.3"(D)

DC Power requirements:

Receive: 60mA with 12 to 13.8V

Transmit: 2.0A on voice peaks, 12 to 13.8V

Frequency coverage:

75M SSB: 3.750 to 3.950 MHz (Can be set to any 200 kHz range on 75-80 Meters)

20M SSB: 14.150 to 14.350 MHz

Band-edge adjustment range: +/- 20kHz

Transmitter:

SSB only

Uses 2 Meter Speaker Mike "Icom Standard" or Radio Shack #19-310 (2.5mm mono mike plug, 3.5mm speaker)

75M LSB Power: 8 Watts pep

20M USB Power: 5 Watts pep

Speech compression

2 Tone IMD distortion products: -35dB

Spurious emissions: - 45dB or better

Receiver:

NE602-Based Super-het, 9MHz IF

5MHz LC VFO, 200kHz tuning range with 8:1 vernier drive built in.

5 Pole crystal filter, 2.7kHz 3dB band width

Audio output power > 1Watt into 8ohms

Audio-derived AGC

RF gain control

Building the Cascade; Do's and Don'ts!!

1. Use a low-wattage, fine-tip iron, heat joint 1/2 second then apply small amount of solder.

2. The resistors are installed standing up, using 0.1" spacing. This was done to conserve board space. Since it will be hard to read the resistor color codes after the part is soldered in, CHECK! each resistor with an Ohm meter before installing it.

3. You must use solder-wick to remove parts. It is the only way to avoid lifing traces due to excess heating.

4. Double-check polarity before installing electrolytic and tantalum caps. With Electrolytic caps, the long lead is the positive side, it goes in the "square" PCB pad. With Tantalum caps, the positive lead is marked with a + sign on the body.

5. T1, T3, T4, T5 & T6 are all 8-Turn bifilar transformers on FT37-43 cores. Twist the two #26 wires (one brown, one green) at 8 twists per inch (use drill if you like). The brown wire goes in the "round pads" the green wire goes in the "square pads"

6. L1, the VFO inductor, should be annealed after winding. Place in boiling water for a few minutes remove and let dry, then coat with Q-dope to hold turns in place. Let dry overnight. L1 is ready to mount on PCB. Don't forget the black insulating washer for L7, it will prevent any shorts to the ground plane.

Construction:

There a several ways to assemble the kit.... One approach has you install all the resistors, then all the capacitors and so on. The testing starts after the board is populated. There are serious problems with this method, as you find out if you pursue it. The main one is that if you have problems it is hard to isolate.

NorCal prefers the build-a-section, test-a-section approach. This test as you go method helps isolate where the problem is... When seeking help you'll have the problem localized to one section. Getting the receiver working first, then adding the transmitter should help simplify trouble shooting when problems crop up..

Test Equipment Needed:

1. 12V power supply. 1.5A peak current demand
2. A speaker mike wireed for Cascade: 2 Meter "Icom" standard or RS #19-310
3. Voltmeter / Ammeter, 1mA resolution
4. General-coverage station receiver
5. RF probe for DVM to measure VFO, BFO and RF levels, or use 50MHz scope
6. HF frequency counter, or use station receiver
7, 10-watt dummy load, 75-meter antenna

The Cascade will be built and tested in ten sections. The first 5 sections get the receiver operating, sections 6 to 9 complete the transmitter portion, and section 10 deals

with the final assembly into the case.

Because of the building-block style of instructions, we have printed the schematic broken-down into several sections. That way you will only have to deal with the section that you are working on. If you want to get the "whole picture" you will need to refer to the blocked text on the schematic, which refers to the sheet that the connection goes to. Another word of caution here: make absolutely sure that you have the right part before you solder. It is not impossible to unsolder a double-sided, plated-through board, but it is not fun as you will find out if you have to do it. If you have inventoried your parts, read the complete manual and are ready, it is time to start with the fun part of building the Cascade. Good luck!!

Cascade Kits were made available to the club members last spring. We sold 200 of them in less than 5 weeks. As of the writing of this article in October, there are 50 more available at $200 + $5 shipping in the US, $10 DX. California residents please add 7.25% sales tax. Contact Jim Cates, 3241 Eastwood Rd., Sacramento, CA 95841, Telephone: 916-487-3580 before you send your money.

It is possible to build this radio ugly construction style, because it was done that way first. If you are planning on buildig it "Ugly Style", you will need 2 band module boards which are available for $7 postage paid from Jim Cates at the address above.

SECTION 1:
DC POWER, 8V REGULATOR

Inspect the board to make sure that all connectors mount flush to the front and rear panels. If you need to file the board, now is the time to do it. Put the connectors on the board, but don't solder yet, and visually inspect to make sure that the front and back panels will fit flush to the edge of the board. This is extremely important for the final appearance of your rig.

When you are satisfied that the contrls will fit the board correctly, mount the following controls and jacks flush to the board edge: C18, J1, J2, J3, J4, J5, R19, R27, R49, S2. Do not install the front and rear panels at this stage, these will be used in step 10.

Don't wire in RG-174 coax to the RF gain pot yet. We'll add a temporary wire jumper to bypass the RF gain control later.

Install 8V regulator U4 and C27, C31, C32, D3, D4 (100 ohm resistor), Q3, R18, R20. Note that C28 is not used and will be left empty. Also, mount a 100 ohm resistor where D4 is indicated. Please refer to the diagram for parts placement.

Mount two board-support brackets, one next to J2 right above where it says R39. Make sure that the bracket is flush with the edge of the board. Mount the other bracket next to J1. Use 6-32 hardware to secure the bracket to the PCB.

Be careful when you solder the BNC jack. It is quite susceptable to heat. It has a tendacy to melt if you apply too much heat.

We are now ready for our first test. Plug in power to the power jack and turn S2 on. Monitor the input current. If it is over 20 mA shut off the power quickly as you have a short. Plug-in the 2-meter speaker Microphone "Kenwood Standard", push the PTT button and confirm the 8TX line goes to 8V DC. Measure 8TX on the collector of Q3. Do not go on until you have confirmed this check.

SECTION 2:
BFO

Install C19, C23, C24, C26, C30, C33, C90, C91, D2, D10, L2, L3, L33, Q1, R15, R17, R22, R59, Y1. Note that R58 is not used and left open. Refer to the VFO/BFO schematic, the BFO is in the upper left. Refer to BFO placement drawing on the next page for this section. NOTE: Identify trimmer C90 by a blue marking on the adjustment slot, trimmer C19 has no color marking on the adjustment slot. Bend C26, C23 leads carefully to fit wider PCB spacing. Also, make sure that you leave about

.025" spacing between Y1 and the surface of the board. Be sure to check the capacitor marking and identifying section before you install caps. It will save you headaches later. L3 and L33 must be mounted in an unusual way. They need to be mounted at a 90 degree angle to each other. Take the 2 coils and twist their leads together and solder so that they look like the view in the drawing. See drawing on how to mount L3 and L33. Mount L33 in the hole for L33 that is closest to the band module. Mount the other end of L3 to the hole that is closest to the front of the board for L3.

Check J2 input current, verify the BFO output voltage level at the junction of R22 and R58 is 600mV peak to peak. One can measure the BFO freqency by zero beating with the station reciever or use a freqency counter attached to R22.

Initial BFO Alignment:

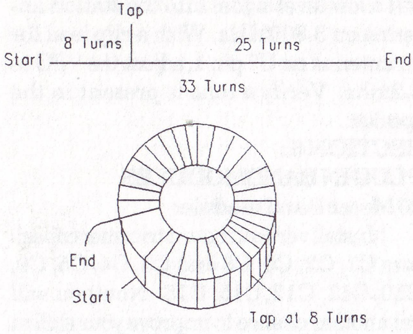
1. Adjust C19 to set 75M BFO frequency at 9.001MHz.
2. Plug-in blank 20M band module PCB into J4
3. Now Adjust the 20M BFO frequency to 8.998MHz
4. Remove 20M band module PCB

SECTION 3:
VFO

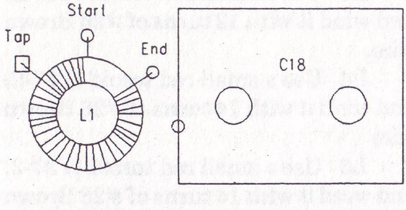
Install VFO components: Q2, C16, C17, C18, C20, C21, C22, C25, C29, C34. C89 is not used, short out with wire jumper. Next install R14, 16, 21, and 57. Note: when installing C18, use the 4-40 screws with the pan heads and the self contained washers. Make sure that the capacitor sits flat on the board and is flush with the edge of the board. If the cap does not sit flat on the board, take a file and run it over the bottom of the cap until the cap sits flat. Also, note that C20, C21, C22 and C25 are all NPO caps. They are disc caps and they have a small black dot on the upper edge.

Now we are ready to wind our first coil, L1. Don't worry, despite what you have heard, it is simple to wind coils. When you finish this kit you will be an expert. Here is how to start. You will find 3 coils of wire in your kit. One is green and two of them are brown. There are 2 different sizes of the brown wire, #26, and #28. The #28 wire is the one that we want to use for this coil. It is the smaller diameter of the two. Cut off a piece of the #28 wire that is 36" long. Prepare one end of it by taking a match or cigarette lighter and burning off the insulation for about 1". Then, take some fine-grit sand paper and run the end of the wire through the sand paper until it is nice and shiny. You should take about 1" of the insulation off this way. Now, pass the wire through the toroid from the bottom and towards you. Then, hold the wire so that the start of the insulation is flush with the edge of the toroid and you have the 1" non-insulated bright piece hanging off the toroid. I like to hold this in my left hand. With the right hand, grasp the other end of the wire and start winding the toroid, being careful to not wind it too tight, but firm. Each time the wire passes throught the center of the "donut" counts as one turn. So, the first time you put it through was 1 turn, and now you have just put it through again for the second one. Do this until you have passed the wire throught the toroid 8 times. Next make a loop with the wire about 1" long. Give the loop 2 twists right against the outside edge of the toroid. This will become the tap. Continue winding until you have wound 33 total turns of wire through the toroid. Look at the diagram. Count the number of turns that go through the toroid, and remember that the first one counts! You should have a total of 33"wires" going through the hole. Leave a lead of about 1", and cut off the excess wire. Now, unwrap one turn. Get the cigarette lighter out again and burn off another 1" of insulation and clean with sandpaper as you did before. Don't forget to put the turn back on after you finish with cleaning it. The last thing is to clean the insulation

off the tap. To do this, hold it over the flame from the cigarette lighter but be careful not to burn the windings of the coil. You just want to clean the insulation from the tap. Use the sand paper to make the wire nice and shiny. The next operation will seem silly to your wife, but it makes for a stable VFO. Take the coil assembly and anneal it by placing in boiling water for 5 or 10 minutes. Take it out of the water and let it cool naturally. Coat the entire coil with Q-dope and let it dry overnight. Now tin all 3 leads with solder, and you are ready to install it.



To install the toroid, you will use the nylon hardware. Take the nylon 6-32 screw, place it through the black shoulder washer, then through the toroid, then through the black insulating washer, and finally through the pcboard. The start of the winding that is closest to the tap goes into the middle pad, the tap goes into the square pad on the left and the other end goes into the pad nearest C18.



When all wires have been placed correcty, place the nylon 6-32 nut on the back of the board and tighten. It doesn't need to be too tight, but it does have to be firm. Make sure that the wires are pulled through the pc board, and solder.

L1 measures 5.1uH between the start and end. If you have an inductance meter verify the inductance value.

Check J2 input current, verify the VFO output voltage level at R57 is 600mV peak to peak. One can measure the VFO freqency by zero beating with the station reciever or using a freqency counter attached to junction of R21 and R57 at Pad 12.

VFO Alignment

1. Set both C17, and C34 to Half Meshed position
2. Set C18 to Fully Meshed position
3. Measure LO using station reciever, should be around 5.150MHz. Write down this frequency value.
4. Install blank 75M band module PCB into J4
5. Subtract 100kHz from frequency in step 3 above. Now adjust C34 so the VFO now oscillates at this new lower frequency. This shifts the VFO when changing bands.
6. Remove 75M band module in J4
7. Adjust C17 for 5.150MHz..... This is the tough part. You'll need to squeeze turns on L1 if C17 doesn't have enough range

VFO Alignment Tips....

1. Removing one turn on L1 shifts the VFO UP 180KHz
2. C34 needs to be about half meshed when finished.
3. L1 inductance should be 5.1uH

After leaving the VFO on for a few minutes, confirm the frequency drift is less than 100Hz shift in 3 minutes.

SECTION 4: AUDIO AMPLIFIER

Install Audio amplifier components C35, C37, C38, C39, C40, C41, C42, C43, C44, C46, C47, C94, C95, C97, C98, D5, D6, D7, D8, D11, Q5, Q17, R24, R25, R26, R27, R28, R55, R56, R64, R65, R67, R69,

R70, R71, R72, U5, U8.

Carefully take a pair of needlenose pliers and bend leads on U5 TDA2002 to fit PCB holes. Do this gently and check for a fit. When installing 1N914 diodes, the "band" end goes in the PCB square pad. C47 and C98 are non-polarized capacitors. They look like electrolytics, but they are "non-polarized", it does not make any difference which lead goes where.

When all audio-section parts have been installed, set R64, the AGC threshold trimpot to mid-range.

Check J2 input current is less than 70mA. Rotate the volume pot R27 to fully clock-wise position. Confirm a "hum" is present in the speaker when touching R27 wiper pin with your finger. The "hum" should drop out when the PTT button on the Mike is pressed. (Be sure to plug in the speaker Mike for this test!!) U5 runs warm to the touch, you may want to add a heat radiator (not supplied with kit).

SECTION 5: IF AND PRODUCT DETECTOR

Install C1, C2, **C3 [NOTE: the drawing and the parts screen shows the leads for C3 reversed. The positive lead of C3 goes to pin 2 of U1]**, C4, C5, C6, C7, C8, C9, C11, C12 **[Note: the drawing and the parts screen shows the leads for C12 reversed. The positive lead of C12 goes to pin 7 of U3]**, C13, C14, C68, C69, C70, C71, C72, C74, C75, C76, C79, C84, C85, C86, C87, C88, C92, Q11, Q13, Q14, Q15, Q16, R1, R2, R3, R4, R5, R6, R7, R9, R10, R11, R12, R47, R48, R51, R52, R60, R61, R62, R63, U1, U6, U7. Refer to IF and Product Detector Schematics

Install Q10, a 2N4124, and R50 near J4. Install 5 crystals and 6 silver mica capacitors C78, C77, C82, C83, C81, C80. The crystals are matched to within 100 Hz. and are in a small envelope. Make sure that you install all five of these crystals in the filter. The loose crystal in the bag of parts is the BFO crystal. Leave a small space (0.025") between the PCB and the case of each crystal. It isn't necessary to ground the case of each crystal to the ground plane. Also populate T4 , T5. (Winding instructions on page 11). Wait until step 7 to populate the the TX Mixer 1, U2 and Mike Amp U3.

Check J2 input current is less than 70ma. Verify DC levels at all NE602's pin 8, should be 6.5 to 7.5 volts. Confirm Q13 source voltage is 1 to 2 volts. Verify +8TX is 7.5 to 8V volts when PTT is closed Install a temporary wire jumper between W1 and W2. This bypasses the RF Gain POT, and will be removed later.

Use the station transceiver to transmit a low level signal into the station antenna on 3.800MHz. With a clip lead for an antenna on U7 pin 1, adjust the VFO to 5.2mhz. Verify a tone is present in the speaker.

SECTION 6 :
PLUG IN BANDMODULES

20 Meter Band module:

Install vertical mount trimmer capacitors C1, C2, C6, C8 and C3, C4, C5, C9, C10, C11, C12, C15, C16. Now you will get another chance to improve your skill at winding toroids. But these are easier than L1, as they don't have a tap. Prepare the wire as in L1 and wind the following toroids using the same procedure to count the turns and then finish the toroid.

L1. Use a small yellow toroid (T37-6) and wind it with 31 turns of #28 Brown wire.

L2. Use a small red toroid (T37-2) and wind it with 12 turns of #26 Brown wire.

L3 Use a small red toroid (T37-2) and wind it with 12 turns of #26 Brown wire.

L4 Use a small red toroid (T37-2) and wind it with 14 turns of #26 Brown wire

L5 Use a small red toroid (T37-2) and wind it with 14 turns of #26 Brown wire

T1 Use a small Yellow toroid (T37-

6). You will have 2 separate pieces of wire for this one. The first is to be the secondary and is 31 Turns of #26 Brown wire, the primary has 3 turns of Green #26 wire.

Wind the secondary first, then wind the primary over the secondary.

75M Band Module Assembly

Install vertical mount trimmer capacitors C1, C2, C6, C8 and C3, C5, C7, C9, C11, C12, C13, C14, C15, C16. Now you will get another chance to improve your skill at winding toroids. But these are easier than L1, as they don't have a tap. Prepare the wire as in L1 and wind the following toroids using the same procedure to count the turns and then finish the toroid.

L1. Use a small black toroid with no marking (FT37-61) and wind it with 30 turns of #28 Brown wire.

L2. Use a small red toroid (T37-2) and wind it with 23 turns of #26 Brown wire.

L3 Use a small red toroid (T37-2) and wind it with 24 turns of #26 Brown wire.

L4 Use a small black toroid with no marking (FT37-61) and wind it with 12 turns of #26 Brown wire.

L5 Use a small black toroid with no marking (FT37-61) and wind it with 12 turns of #26 Brown wire.

T1 Use a small black toroid with no marking (FT37-61). You will have 2 separate pieces of wire for this one. The first is to be the secondary and is 30 Turns of #28 Brown wire, the primary has 2 turns of Green #26 wire.

Wind the secondary first, then wind the primary over the secondary.

Band Module Alignment:

Now we are ready to do some aligning. Install the 75M bandmodule. Verify VFO frequencies listed in step 3 again. Connect the 75M station antenna to the Cascade. Now peak the band module preselector caps C1, C2 for strongest back ground noise level. Tune in a station and re-peak C1, C2. Receiver should be functional at this point, adjust BFO for best audio quality. (Make the received signal sound normal. This is best done by listening to someone whose voice you know.) Write down your BFO freqency.

Repeat with 20M bandmodule installed. Peak 20M bandmodule preselector caps C1, C2 for strongest back ground noise level. Tune in a station and re-peak C1, C2

Tune in a "strong" S9 plus signal on the band, verify Q17 gate voltage drops from 3 to 4 volts down to 2 to 3 volts. Confirm receiver audio mutes when PTT is closed. Verify RF gain pot operates correctly. This completes the reciever section. Resist going on until you are satisfied the receiver is working properly.

SECTION 7: MICROPHONE AMPLIFIER

Install Microphone amplifier components, C10, Q12, U2, U3. Leave R8, C15, R13 out, they are not needed with the Radio Shack speaker mike. All the parts on the Product Detector schematic should now be populated. **Note the C12 polarity pad is wrong, plus side to U3 pin 7.** Note 22uF electrolytic caps aren't marked for polarity. SHORT LEAD is negative. Insert LONG lead into SQUARE pads.

Testing:

Connect a Kenwood or Radio Shack 2meter Speaker Mike. Verify the "MIKE" pin on J1 pin 2 is 2V DC when the PTT button is closed. Check U3 DC levels at pin 8 is 1 to 2 volts. Close PTT, speak into mike, confirm audio level at U3 pin 8 is at least 75 to 125mV peak to peak. Adjust R7 for equal DC voltage on U2 pin 1 and 2. This gets the carrier balance close.

SECTION 8: POWER AMPLIFIER

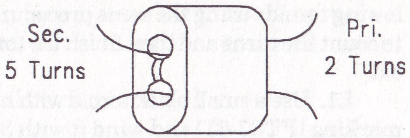
Install PA chain components: C49, C50, C51, C52, C53, C55, C56, C57, C58, C59, C60, C62, C63, C64, C65, C66, C67, D12 [**Note: Install D12 vertical with the**

banded end closest to the board. See drawing in Section 9 for details.], L4, L5, Q6 **[Note: The PCB screen is wrong for the type of 2N2222 transistor that we supplied. There is a tab on the metal can 2N2222A, it should point towards the Q6 on the parts layout]**, Q8, R31, R32, R33, R34, R36, R38, R39, R40, R41, R42, R43, R44, R45 **[Note: their are 2 trimpots in the kit. One is marked 500, it is a 50 ohm pot and is a mistake. Use the blue trimpot marked 501, it is the correct value, 500 ohms]**, R46, R99, T1, T2, T3, T6. Install 75M band module in J4.

It is time to wind some more toroids, and you are about to learn another skill. This time you will be winding a bifilar toroid, which means that you will use two different colors of wire. The kit is supplied with 3 rolls of wire, a brown #26, a brown #28, and a green #26. You will use the brown #26 and the green #26 to wind the bifilar T1, 3, 4, 5, & 6. The #26 brown wire is the larger of the two brown wires in diameter. Cut off a 10" piece of each wire, prepare one end of each color as before, and then holding the two prepared ends together, twist the two wires so that there are about 8 twists per inch. When you finish, wind the toroid with 8 turns and then prepare the ends as before. The easiest way is to unwind 1 turn after you finish winding, prepare the ends, and then put the turn back on the toroid. You will place the brown wire ends in the round pads and the green wire ends in the square pads.

Install a heat sink on Q8. It is the TO5 style and is round. If you have some heatsink compound, it would be a good idea to put some on.

Next we will wind the PA output transformer, T2. This is the dark gray form that has two holes. We will use 5 turns of #26 magnet on the Low Pass filter side and 2 turns of #26 on the Q7 collector side. To wind five turns start on one end with a piece of the brown wire in your kit. Put the wire through one of the holes then bring it back through the other hole. This counts as one turn. Put the wire back through the hole again, and bring it back through the second hole. You should have 2 wires through each hole and the start and the end of the wire are on the same end of the form. Repeat this until you have 5 wires in each hole. This is the 5 turn side. Now, start at the opposite end of the form and wind 2 turns of wire with the second piece of insulated wire. This is the Primary. It should have 2 turns or wires in each hole, and the two primary wires should be outside the same end as shown in the drawing.



PA Transformer

Testing:

Press PTT, verify Q6 emitter voltage is 0.5 to 1 V, verify Q8 emitter voltage is 0.5 to 1 V. Adjust R45 for highest voltage on D12. Verify 12V collector voltage on Q6, Q8 and Q7(not installed yet)

Now confirm the transmitted 75M RF levels in PA chain. Close PTT, speak into mike, R46 should have 1/2 to 1 volt peak to peak of 75M RF. R99, a 20-ohm base resisitor should have 2 to 4 V peak to peak of 75M RF across it.

You'll need to peak the two transmit filter trimmer capacitors C3, C4 on the band module board. Adjust C3 and C4 for maxium RF level at R99. While speaking into the mic, verify the RF signal at R99 doesn't appear "clipped" on the scope.

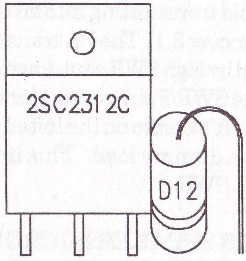
To listen to the Cascade transmitter audio use HEADPHONES on your station receiver while speaking into the Cascade mic. Tune in the transmitted signal on the station receiver. A dummy load on the Cascade isn't needed, the 2SC2312 isn't installed yet.

The transmitted audio should be free

of distortion, now adjust BFO capacitor for "best transmitted audio". This will take some time to get a feel for the right position After adjusting the BFO cap you'll need to retune the station receiver. Don't install Q7 until you're satisfied with the "clarity" of the Cascade transmitted audio heard in your station receiver. If you're using the Radio Shack speaker-mike try holding the mike about 3 inches from your mouth, holding it closer adds excessive wind noise. Write down your BFO frequencies for future reference.

SECTION 9: PA FINAL

Install the Q7 2SC2312. Position Q7 in contact with the bias temperature compensation diode D12. D12 needs to be in physical contact with the plastic case of Q7. **DON'T SOLDER YET!**



Place the 2SC2312 in the board, and make sure that it makes contact with D12 as shown above. Attach the back panel using the hardware for the BNC connector and the screw in the angle bracket. Carefully mark the position of the hole to mount the transistor on the back panel. Do this carefully, and try to be sure that the transistor is seated fully and making contact with the diode. After marking, remove the back panel, use a center punch to mark the spot for drilling, and drill a 1/8 inch hole in the back panel. Secure Q7 to the panel using a mica washer and 4-40 hardware. If you have heat sink compound, use it when securing Q7, apply some to D12 also. Attach the panel to the circuit board and try to avoid taking it off in the future.

Connect a 50 ohm, 10 watt dummy load to the antenna jack J5. Place a 2A ammeter in series with the 12V DC supply. Close the PTT, slowly decrease R45 while monitoring the J2 12V supply current. Adjust R41 so the idle supply current increases from 70mA to 250mA during TX. Do this with out speaking into the mic. Confirm the Voltage at D12 is approximately .7 volts.

Now repeat the same audio test in Section 8 above. Listen to the transmitted audio in your station receiver using headphones. The audio should be free of distortion as before. Confirm the J2 12V supply current peaks to 3/4 to 1 1/4 amp on voice peaks. Over-driving the NE602 first transmit mixer can cause distorted audio. To reduce the drive level, reduce the mike gain resistor R63 from 10K TO 4.7K.

Use a calibrated watt meter to verify the output power levels on both bands. Verify the peak RF levels at J5, the antenna jack, are 50 to 60 Volts peak-to-peak on 75M, 40 to 50 volts peak-to-peak on 20M. Five watts pep equates to 45V peak-to-peak into a resistive 50 Ohm load.

Now readjust the carrier balance R7. Un-plug the mike connector, close the PTT line with a clip lead. Null the 9MHz RF carrier seen at the antenna jack You should be able to reduce it to under 0.5V peak to peak.

If you use a battery for the 12V supply, make sure it doesn't drop below 11 Volts. It is a good idea to check this often.

SECTION 10: FINAL ASSEMBLY

We are ready for the final assembly of the Cascade into the Case. Attach the front panel, using the appropriate screws. The 3 screws for the tuning capacitor may have to be filed down. We were unable to obtain a supply of 3/16" long screws, so we supplied 1/4" instead. You will have to

file them so that they just fit through the capacitor, but don't touch the plates. You should have at least 1/16" clearance between the end of the screw and the front plate of the capacitor.. Put the nuts and washers on the controls, the 6-32 screw in the bracket, and you are finished with the panel. Now attach the pointer to the hub, and the hub to the shaft, being careful to insure that you get it adjusted correctly so that the pointer won't rub on the panel. Check the pots to make sure that the tabs have been broken off so the panel fits flush. It is important to get the nuts on the mic jack.

You should have the front and back panels both mounted. The next operation is to remove the tempory wire jumper between W1 and W2. Use solder wick. Cut a piece of the tiny coax cable to fit between W1 near the front panel and W1 next to the band module. You will install this on the bottom of the board. The coax is only grounded at one end, the one nearest the band module. **DO NOT GROUND** the end of the coax nearest the front of the board. The center conductor of the coax is connected at both ends, but the braid is only connected on the end closest to the band module.

Install W2 in the same manner as W1, remembering that the coax is only grounded nearest to the band module end.

Next mount the plastic latches on the bottom of the case. That is the one with the two mounting holes drilled in the bottom. Use the 2 flat head 1/4" 4-40 screws to mount the circuit board to the case bottom. All that is left is to put the catches on the top of the case, snap it on, and your Cascade is finished except for painting and labeling.

We are leaving the labeling of the Cascade up to you. That is what makes a home brew rig unique and it gives you the opportunity to "customize" your rig. We are not providing a screen service as we did for the NorCal 40 and the Sierra. It just became too big of a job, and it lasted far too long.

If you decide to paint your Cascade, **DO NOT** Paint the inside of the panels!! Also, each time that you remove the back panel, be sure to apply more heat conductive grease to the final.

CASCADE OPERATION NOTES

12V POWER REQUIREMENTS

You'll need a supply capable of 2 amps on voice peaks. It's a good idea to monitor both the 12V input current and voltage during your initial check out. When operating the rig with a battery select one with enough capacity. Lead acid batteries should be rated at 4A/hr and Nicad batteries should be rated at 2.2A/hr.

ANTENNA

Avoid transmitting into an unknown VSWR or over 3:1. The PA transistor isn't protected by high SWR shut down circuitry. An inline SWR/Pout wattmeter is recommended. It's best to do the initial rig check out into a dummy load. This insures an excellent SWR.

2 METER SPEAKER MICROPHONE

The rig accommodates a "Icom standard" speaker microphone. These microphones come in two sizes. The larger style will have better fidelity for SSB. The compact microphone style has a lot of distortion. Several prototype builders purchased the Radio Shack Microphone for $19.95. This gave adequate performance

Resist the natural temptation to shout or "close talk". The microphone amplifier chain has a sensitive speech processor. Holding the microphone about 3 inches from your mouth is about right. Soliciting on the air transmitted audio reports is the best way to know if everything is working as it should. If you have more the one microphone, see which one works best.

RF/AF GAIN

It's best to set the AF gain at a moderate level, RF gain fully clockwise. Lower the RF gain if extreme signal levels are present or the background noise level is to high.

INTERNAL ADJUSTMENTS

BFO

This is the critical one. It's a bit touchy to get right. The BFO trimmer sets the pitch range on the receiver and transmitted audio. Start by adjusting the 75m trimmer C90. Find a solid S9 signal on the 75m band, adjust until the the audio has enough highs and lows. You'll need to touch up the VFO as you move the BFO. As a final tweak, do an on the air transmitted audio test with a fellow ham. Try a small change and see if it is better or worse.

Another BFO alignment technique is to measure the 3dB passband. Here you'll adjust the BFO to set the 3dB points at 300Hz and 3000Hz. One can do this with only a DVM and station transmitter as a signal source. Use your station transmitter to radiate a steady S9 carrier into the Cascade receiver. Connect the DVM set to AC volts across the speaker terminals. Use the transmitter's incremental TX tuning to find the 3dB points in the pass band, 70% reduction in voltage. Adjust the BFO to get these at 300 and 3000Hz.

Carrier Balance

You'll need a QRP watt meter for this one. Set it to its lowest scale, 1W full-scale. Key the microphone, and without speaking adjust for minimum output.

PA Bias

Measure the voltage drop across R80. We'll want to set the voltage for Iceq = 250mA or 250mV from R80 to ground.

AGC Threshold

Set to mid-range of pot rotation. Find a " strong S9+ " station start turning the pot CCW. When the audio starts to drop, back off 1/4T.

1. DC Voltage Chart for Active Devices

Conditions: Receiving, no signal, 14.1V power supply, using a DVM.

Device	Pin	Voltage to Ground
U1	1	1.41
	2	1.41
	3	0
	4	5.59
	5	5.58
	6	6.68
	7	6.07
	8	6.75
U2	1	1.27
	2	1.27
	3	0
	4	5.97
	5	5.58
	6	6.68
	7	6.07
	8	6.91
U3	1	0
	2	3.64
	3	7.62
	4	1.75
	5	1.73
	6	0
	7	1.36
	8	1.36
U4	1	13.88
	2	0
	3	7.98
U5	1	1.42
	2	0.82
	3	0
	4	6.35
	5	13.86
U7	1	1.41
	2	1.41
	3	0

	4	5.52
	5	5.53
	6	6.66
	7	5.98
	8	6.72
U8	1	7.98
	2	7.98
	3	7.97
	4	0
	8	13.88
Q1	S	0
	G	0
	D	7.91
Q2	S	0
	G	0
	D	7.90
Q3	E	7.99
	B	7.98
	C	0
Q5	S	6.72
	G	13.84
	D	0
Q11	S	6.72
	G	13.92
	D	6.73
Q12	S	1.94
	G	0
	D	7.98
Q17	S	5.56
	G	3.42
	D	5.56

Conditions: Transmitting, no audio, 14.07V power supply, DVM.

U6	1	1.40
	2	1.40
	3	0
	4	5.06
	5	5.02
	6	6.16
	7	5.49
	8	6.21
Q6	E	0.53
	B	1.19
	C	13.0
Q7	E	0.084
	B	0.74
	C	13.66
Q8	E	1.08
	B	1.82
	C	13.67
Q10	E	0
	B	0.78
	C	0
Q13	S	1.73
	G	0
	D	7.41
Q14	S	0
	G	0
	D	7.40
Q15	S	0.92
	G	7.40
	D	0.92
Q16	S	0
	G	7.36
	D	0

2. Check BFO and LO Signal Sources:

Measure TX BFO injection level U2 pin 6:
175mV rms TX, PTT closed
Measure TX VFO injection level U6 pin 6: 175mV rms TX, PTT closed
Measure RX BFO injection level U1 pin 6: 175mV rms RX
Measure RX VFO injection level U7 pin 6: 175mV rms RX
Measure 20M BFO frequency:
8998.0KHz typical

Measure 75m BFO frequency:
9001.0KHz typical
Measure 20M VFO band limits:
5.15MHz to 5.35MHz
Measure 75M VFO band limits:
5.05MHz to 5.25MHz

3. Trace Receiver signal path with a 5mV rms signal at the antenna jack.

RX Mixer 1 output at U7 pin 4:
100mV rms
IF filter output at U1 pin 1:
50mV rms
RX Mixer 2 output at U1 pin 4:
6mV rms DMM only AC V
AF pre-amplifier output at U8 pin 1:
120mV DMM only AC V
AF power amplifier output at U5 pin 4:

AF output at speaker jack:

AGC voltage at Q17 gate:

4. Additional Reciver Checks

IF Bandwidth:
2900Hz at 6dB (1/2 voltage) points
RX DC current drain:
65mA

5. Trace Transmitter Signal Path

Press PTT switch and whistle into mike. Note: values measured Voltage peak to voltage peak, divide by 2.8 to compute RMS value.
Mic bias at J1 pin 2:
2 volts DC
Mic pre-amp output at Q12 source:
50mV
Mic amplifer outut at U3 pin 8:
400mV
TX Mixer 1 audio injection level at U2 pin 1:
150mV

Mic amplifier output

TX Mixer 2 output level at U6 pin 5:
300mV
TX amplifer output at Q13 source:
300mV
TX Spur Filter output level at Q6 base:
200mV
TX Buffer amplifier output at Q8 base:
1.5V
TX Drive amplifier output at Q7 base:
3.0V
TX PA output J4 pin 5:
45V
TX output at antenna jack:
40V

6. Additional Transmitter Checks

TX 12V current drain on voice peaks:
1.7A
TX 12V current drain PTT close, don't talk:
290mA

CASCADE OPTIONS:

17M / 40M Conversion

The first option describes circuit value changes to put the rig on 40 and 17 meters. This modification is complex, seek the help of an experienced member if you're unsure.

Several changes need to be made; VFO and BFO, IF crystal filter, Low pass filter, TX spur filter, and RX pre-selector filter. You will need two blank 20M bandmodule boards, or with some reworking, 2 blank Sierra band module boards.

I'd make sure the rig works as it should on 75/20 meters, then rework the rig to operate on 17/40M. This approach is a lot more time consuming but you'll know that everything else works before starting to change all the filters.

12.288MHz Crystal Filter

The IF crystal filter changes from a 9MHz to a 12.288MHz center frequency. You'll need to buy 10 to 12 crystals from Digikey. Next measure each crytal's series resonate resistance, and frequency shift values. G3UUR describes how all this is done in a recent (June, 1995 ARRL QEX) ar-

ticle titled "Refinements in Crystal Ladder Filter Design" by Wes Hayward

The filter article shows how to calculate the motional capacitance and Q values needed to design a filter. I used Wes Hayward's filter program to designed a Butterworth SSB filter using the following crystal parameters. Confirm your measured crystal nominal parameters are similar.

Case HC49/U ONLY
F-series = 12.288MHz
R-series = 15 ohms
L-motional = 0.0063H
Cp = 5pF
Q = 31,000

Select 5 crystals from your batch of 10 crystals that match within 150Hz. The 12.288 MHz filter's 3dB Bandwidth is 2700Hz and the R-termination 750 ohms.

Component value changes:
Y2-Y6 HC49 12.288MHz crystals
C77, C81 47pF 5% silver mica
C79 39pF 5% silver mica
C78 C80 68pF 5% silver mica
C82,C83 120pF 5% silver mica
Cin Cout 10pF 5% ceramic
(Add Cin and Cout to input and output of filter, shunts to ground)

TX Low Pass Filters

Use 20M bandmodule board

	40M	17M
C12,C16	390pF	180pF 5% 200V cer.
C15	820pF	330pF 5% 200V cer.
L2, L3	T37-2 18T 1.36uH	T37-6 14T 0.57uH

RX Pre-selector Filter

Use 20M bandmodule board

	40M	17M
L1	FT37-61 16T 14uH	T37-6 24T 1.7uH
T1	FT37-61 16T 14uH Primary 1T	T37-6 24T 1.7uH Primary 2T

TX Spur Filter

Use 20M bandmodule board

	40M	17M
L4,L5	T37-2 16T 1.02uH	T37-2 16T 1.02uH
C3,C11	330pF	180pF 5% ceramic
C4,C10	100pF	22pF 5% ceramic
C7	22pF	2.5pF (two 5pF in series) 5% ceramic
C5, C9	330pF	22pF 5% ceramic
Bandwidth:	400KHz	800KHz
R-terminations:	50 ohms	50 ohms

BFO

Y1 change to 12.288MHz Crystal

5MHz VFO

To tune the 40M phone segment with a 12.288MHz IF, the VFO needs to shift down slightly. For the 17M phone segment, the VFO needs to shift up 850kHz. Since the 17M phone subband is only 58kHz wide the tuning range is also reduced from 200kHz to 60kHz.

40M VFO

4.988MHz to 5.138MHz
J4 pins 25 to 23 SHORTED

17M VFO

5.822MHz to 5.880MHz
J4 pins 25 to 23 OPEN
L1 No change 5.1uH 33T total T50-7 Tap at 8T

C22 now 47pF ceramic NP0
C34 add 220pF ceramic NP0 in parallel
C89 not used short with wire
Connect J4 pin 23 ground return to junction of C22 and C25 NOT to ground. This pad is just to the left of trimmer C34, cut away ground and reconnect.

VFO Aligment:

1. If possible measure L1, should be 5.1uH
2. Install 40M bandmodule board with J4 25 to 23 shorted
3. Set C18 to Fully meshed position
4. Measure VFO frequency using station reciever, should be around 4.988MHz. Write down the frequency.
5. Remove 40M band module board
6. Subtract 850kHz from frequency in step 4. Adjust C34 so the VFO now oscillates at the new higher frequency.
7. Reinstall the 40M band module board. Adjust C17 to reach 4.988MHz. Add additional shunt C to C17 to reach 4.988MHz if frequency is too high. Start with a small amount, i.e. 10pF NP0.
8. Check tuning range on 40M is at least 200kHz, Check tuning range on 17M is at least 60kHz.

Cascade Parts List

C1, 16, 24, 37, 42, 43, 49, 50, 51, 52, 55, 56, 57, 58, 59, 60, 62, 74, 75, 84, 88, 92, 95, 100	0.1uF
C2, 4	47pF
C3, 9, 11, 12, 13, 32, 33, 40, 47, 67, 87	2.2/25V Elect/Tant
C5, 7, 8, 53, 63, 68, 69, 70, 71, 91	.047uF
C6	220pF
C10	1000pF
C14, 15, 65, 66, 86	22/25V Elect.
C17	2-12pF Air Trimmer
C34	2-20pF Air Trimmer

Note: Mouser 530-189-0509-5 will sub for C17 & C34

C18	5-40pF/w 8:1 Drive
C19	2-12 Trimcap
C20, 76	5pF NPO
C21	82pF NPO
C22	270pF NPO
C23	47pF NPO
C25	100pF NPO
C26	10pF
C27, 31, 35, 39	100uF/25V Elect.
C29, 30, 72, 73	470pF
C38, 44, 94	.47uF
C99	10uF/25V Elect.
C41	.22uF
C46	.01uF
C47	2.2uF Non Polarized
C64	.001uF
C77, 81	150pF SM
C78, 80	47pF SM
C79	56pF SM
C85	.02uF
C89	Wire Jump
C90	4-20pF Trimcap
C96	1uF Non Polarized
C97	.002uF
C99	10uF/25V
D1, 2, 5, 6, 7, 8, 10	1N914
D3	1N5819
D4	100 ohm resistor
D12	1N4001
J1	2.5mm Mono Jack
J2	2.1MM DC Jack
J3	3.5mm Stereo Jack
J5	BNC JACK
L1	5.1uH - T50-7 33T - Tap 8T
L2	33uH - RFC

L3	15uH - RFC
L4	56uH - FT37-43 15T
L5	56uH - FT37-43 15T
L33	15uH - RFC
Q1,2	2N4416A
Q3	2N3906
Q5, 11, 15, 16	2N7000
Q6	2N2222A
Q7	2SC2312C
Q8	2N3866
Q10	2N4124
Q12 , 13	J310
Q14	J176
Q17	2N5484
R1, 14, 15	1M
R2, 11, 59, 73, 97, 98	10K
R3, 9, 10, 47, 48	470
R4, 13, 36, 39, 63, 72	1K
R5, 6, 20, 56, 65, 68, 69	47K
R7	1K Trimpot
R8	Open
R12, 17, 31,38	47
R16, 97	100
R18, 19, 21, 35, 54, 60	4.7K
61, 70	4.7K
R22, 26, 57, 62	2.2K
R24, 55	4.7M
R25	2.2
R27	1K Pot
R28	200
R32	39
R33	4.7
R34, 44	560
R40	150 - 1Watt
R41	180
R42, 99	20
R45	500 TRIM
R46, 51	390
R49	1K POT
R50	1.8K
R52	1.5K
R58	Open
R64	10K TRIM POT
R67	1.1
R80, 81	1.0
S2	SPST
T1, 3, 4, 5, 6	27uH 8T Bifilar FT37-43
T2	B43-201 2T Pri 5T Sec
U1, 2, 6, 7	NE602AN
U3	SL6270
U4	UA78L08C
U5	LM383, UPC2002
U8	NE5532
Y1, 2, 3, 4, 5, 6	9.000 Crystal Matched to 100 Hz.

20 Meter Band Module

C1, 2, 6, 8	9-50 pF Trimmer
C3, 11, 15	470pF
C10, 4	47pF
C5, 9	82pF
C7	5pF
C12, 16	220pF
L1	2.9uH 31T T37-6
L2, 3	.58uH 12T T37-2
L4, 5	.78uH 14T T37-2
T1	2.9uH 31T/3T T37-6

75 Meter Band Module

C1, 2, 8, 6	9-50pF Trimmer
C3, 11,	1800pF
C15	1200pF
C5, 9	220pF
C7	2700pF
C12	680pF
C13, 14	150pF
C16	560pF
L1	50uH 30T FT37-61
L2	2.1uH 23T T37-2
L4, 5	7.96uH 12T FT37-61
T1	50uH 30T/2T FT37-61

DESIGNER'S NOTES:

I'd like to thank the many NorCal members that made this kit possible, and especially you who bought the kit solely on NorCal's excellent reputation.

Jim Cates, finance manager, who oversaw that NorCal standards were met.

Doug Hendricks, QRPp editor, who prepared over 200 Cascade parts kits, edited text, schematics, charts and drawings into an outstanding kit manual, acquired and sorted over 64,000 high quality parts (many purchased at unheard of savings) for

NorCal members. Doug has been a joy to work with during the past 10 months. His endless enthusiasm for QRP keeps us all going.

Prototype kit builders; Dave Meacham, Doug Hendricks, Vern Wright, and John Koenig. Dave was a key technical contributor and helped refine the design.

Jeanette Hayes and Terry Sherbeck for PCB design assistance.

Early design consultants; the entire BC (SSB) QRP gang, Derry Spittle, Bruce Gellatly, and Joe Stipek. Wayne Burdick, Wes Hayward, and Roy Lewallyn.

I hope you enjoy the challenge of building a SSB transceiver. NorCal has a lot of members to team up with to build and test the Cascade. Contact Doug Hendricks, KI6DS, Dave Meacham, W6EMD, or myself, K7RO, we'll be thrilled to assist you.

I have great hopes for the Cascade, I think it ties into one of the major interests in ham radio - TALKING! Now, chatting with friends can be done on a rig you built yourself. I suspect most of you will want to add to the basic Cascade design. I encourage you to let Doug or I know what you've accomplished. Who will be the first to add CW? Who will add a digital display?

72, John

Moxon Rectangles for 40-10 Meters

by L.B. Cebik, W4RNL
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email: cebik@utkvx.utk.edu

Since a postin on QRP-L, the Moxon rectangle has drawn considerable attention. A full analysis of the antenna appears in the Spring, 1995, issue of *Communications Quarterly*.

Basically, the Moxon rectangle is a wire antenna that can be fix-mounted or rotated. It is directional with about the gain of a 2 element Yagi (6 dBi in free space) and has an outstanding front-to-back ratio (greater than 40 dB in free space), with a very broad frontal lobe (-3 dB beamwidth = 70 degrees, usable beamwidth = nearly 180 degrees forward). The basic outline of the antenna appears in Figure 1.

Since the article and the posting appeared, I have heard of successful constructions of Moxon's, one for a Field Day Novice station. I have also had two types of requests. One has asked for dimensions for other bands. The other inquiry wondered if the feedpoint impedance might be brought closer to 50 ohms. The original design showed a feedpoint impedance close to 80 ohms.

I remodeled the antenna with good results on both counts. Table 1 provides dimensions for the Moxon rectangle for 40 through 10 meters. The dimensions are not perfect simple scalings, because the length-to-wire-diameter ratio changes for each ham band.

All of the antennas exhibit feedpoint impedances between about 56 and 58 ohms, a close match to the standard amateur 50 ohm coaxial cable. Free space gain and front-to-back ratio are consistent for all the models, averaging 5.8 dBi and greater than 32 dB in free space, respectively. Figure 2 shows a typical free space azimuth pattern for the antenna.

All of the models use #14 copper wire, although the various factors that contribute to the Moxon pattern tend to cancel out as wire size increases. Hence, a tubing model will have dimensions close to those for a thin wire model. However, it will exhibit a broader SWR bandwidth. The models were constructed on EZNEC, a NEC-2 implementation by W7EL.

At heights below 1/2 wavelength, the front-to-back ratio will deteriorate somewhat, but usable values can be obtained. Figure 3 shows the azimuth pattern of a Moxon Rectangle at the elevation of maxi-

mum radiation, with a height of a half wavelength above real, medium ground. The bandwidth for 2:1 SWR is only about 100 kHz on 40 with #14 wire. Above 40, the 2:1 SWR bandwidth covers the entire amateur band. For 30 and up, the front-to-back ratio is better than 15 dB across the band.

The original article showed one construction technique for 10 meters. Many others are possible, whether the material is wire or aluminum tubing. I shall leave the exact methods to the reader's ingenuity.

The standard of comparison for the Moxon is the 2-element Yagi. While a Yagi has marginally more gain, the Moxon's front-to-back ratio is very much superior. It will likely improve your ears much more than it will diminish your voice. And, as the old but true saying goes, if you can't hear 'em, you can't work 'em.

Moxon Dimensions for 40 - 10 Meters
Dimensions in Feet

Band	Freq.(MHz)	A	B	C	D	E
10	28.50	12.44	1.94	0.41	2.41	4.76
12	24.94	14.22	2.22	0.46	2.76	5.44
15	21.20	16.72	2.63	0.52	3.25	6.40
17	18.12	19.56	3.10	0.59	3.80	7.49
20	14.17	25.00	4.00	0.72	4.85	9.57
30	10.12	35.00	5.60	1.00	6.80	13.40
40	7.15	49.56	8.01	1.33	9.63	18.97

Note: All models composed of #14 copper wire.

Table 1

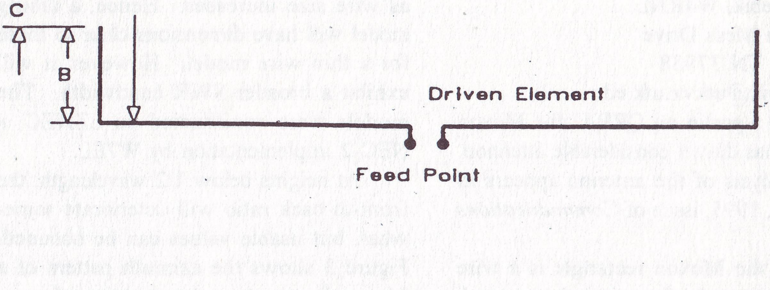


Fig. 1

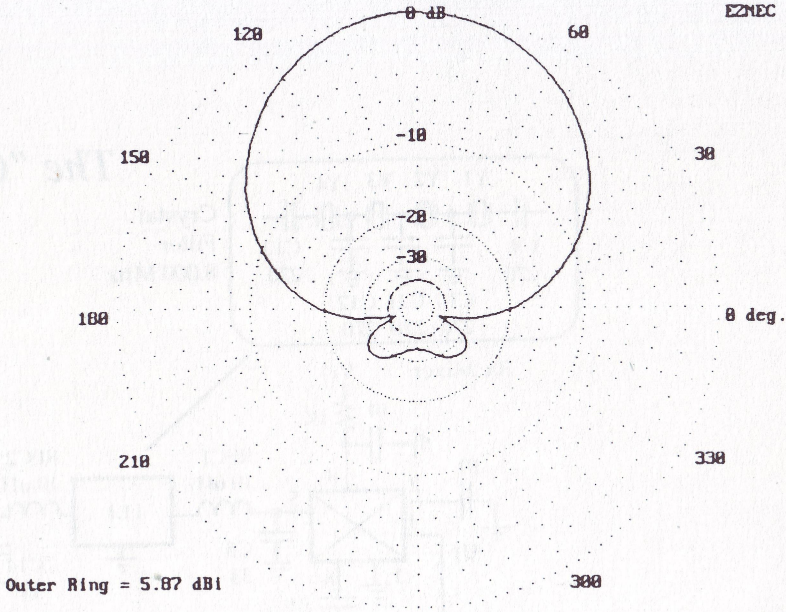

EZNEC
0 dB
120
60
-10
150
30
-20
-30
180
0 deg.
210
330
Outer Ring = 5.87 dBi
300

Fig. 2

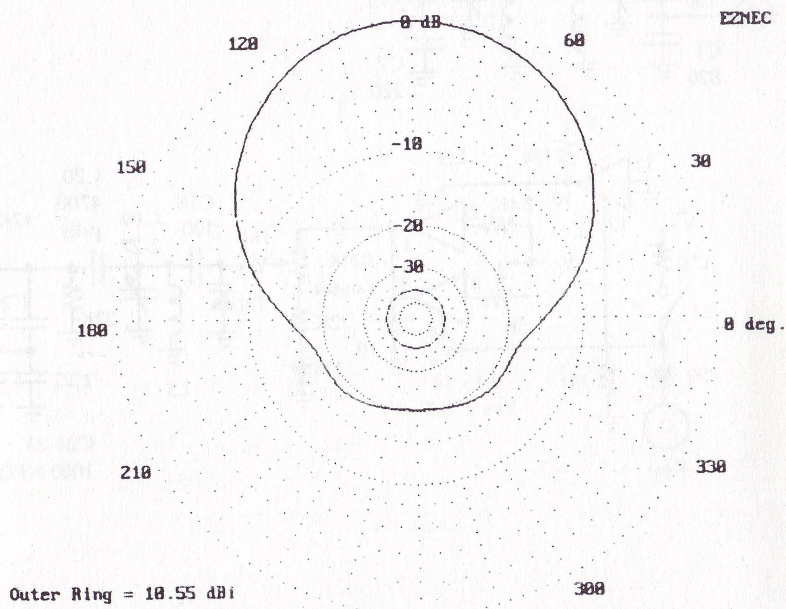
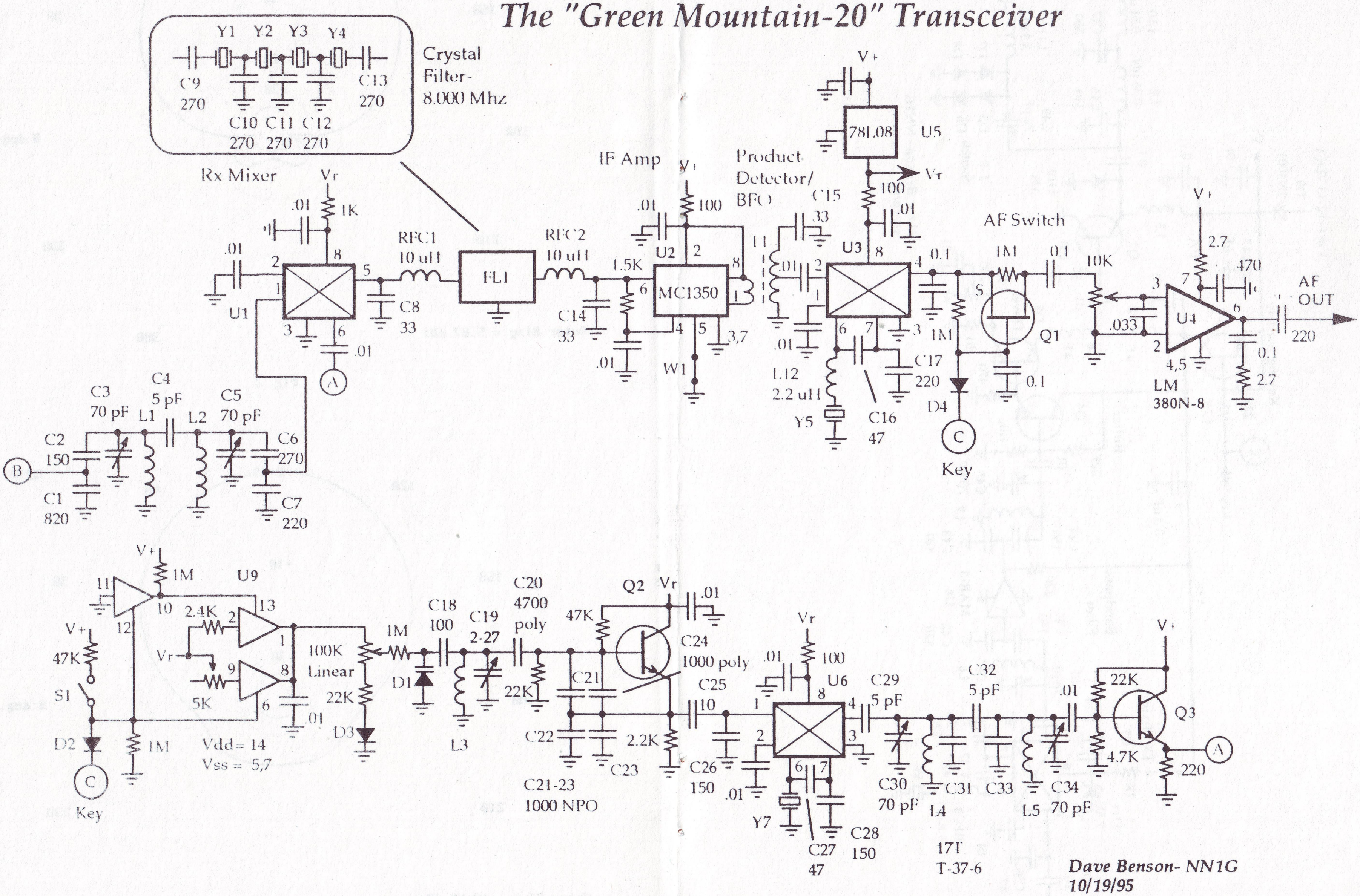

EZNEC
0 dB
120
60
-10
150
30
-20
-30
180
0 deg.
210
330
Outer Ring = 10.55 dBi
300

Fig. 3

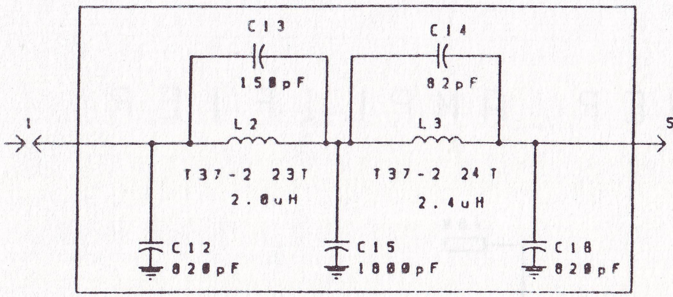
The "Green Mountain-20" Transceiver



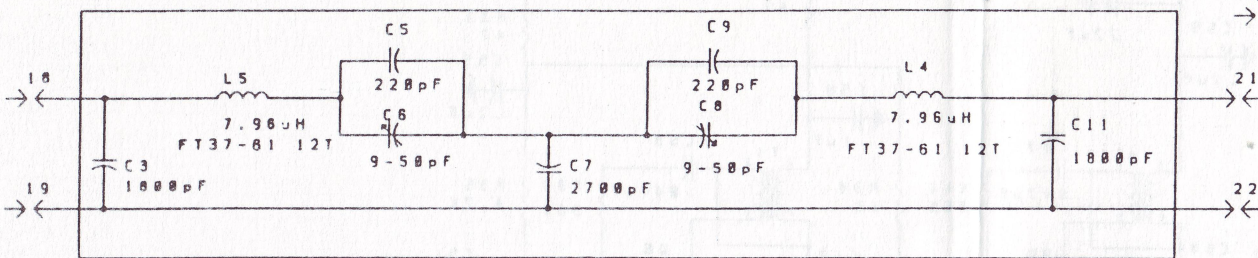
Dave Benson- NN1G
10/19/95

75m BAND MODULE

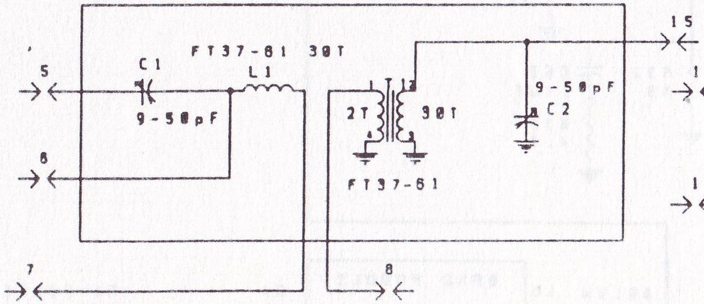
75m LOW PASS



75m TX FILTER

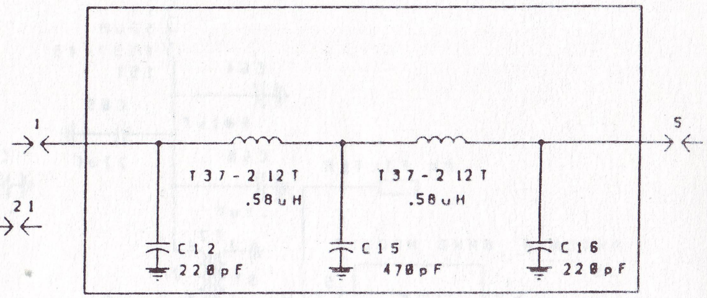


75m RX FILTER

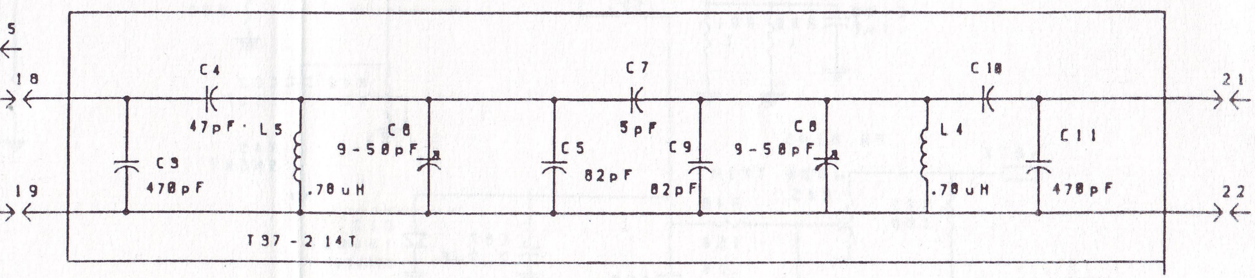


20M BAND MODULE

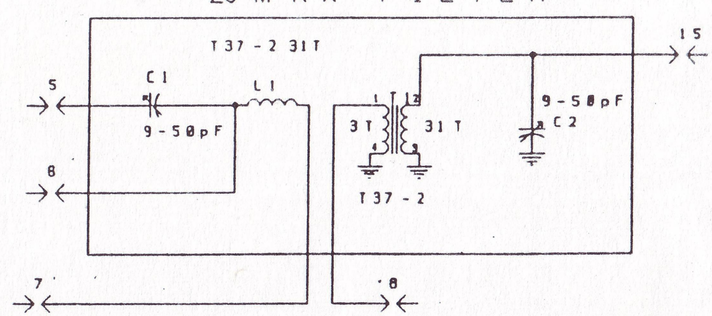
20M LOW PASS



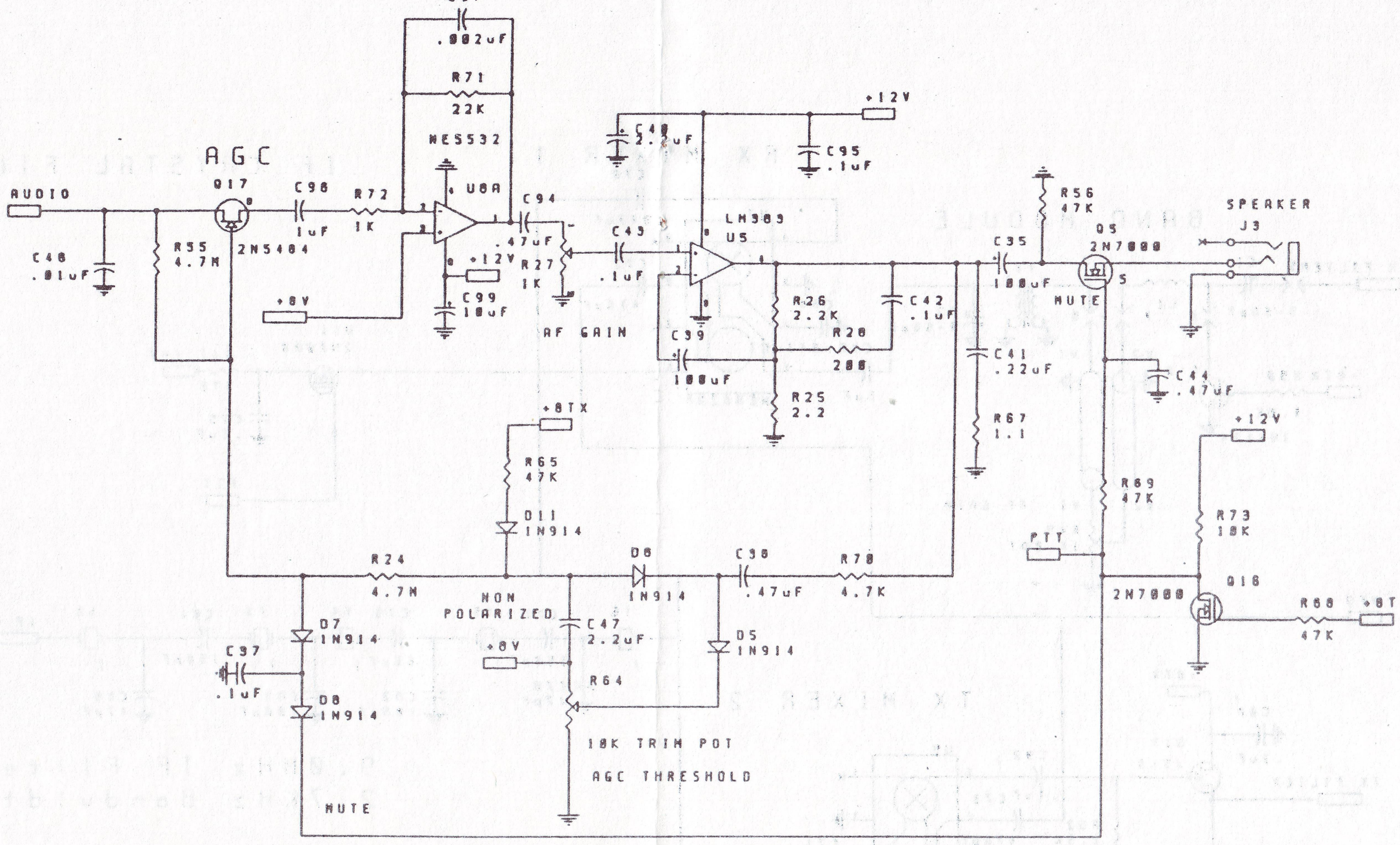
20M TX FILTER



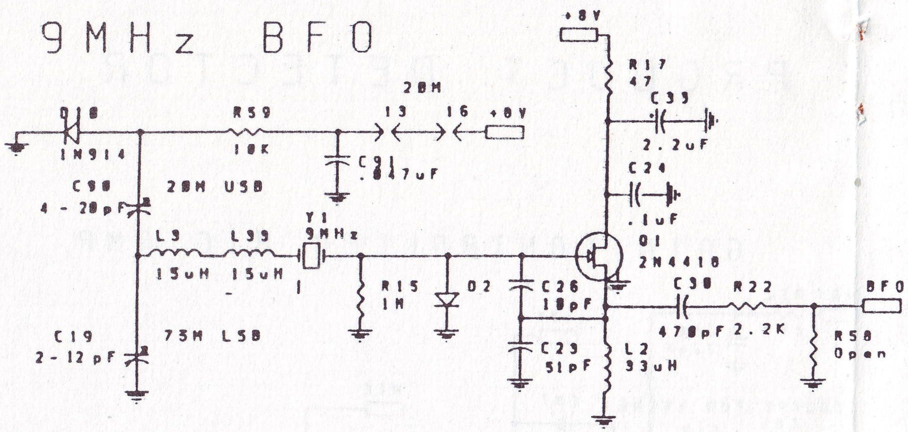
20M RX FILTER



AUDIO AMPLIFIER

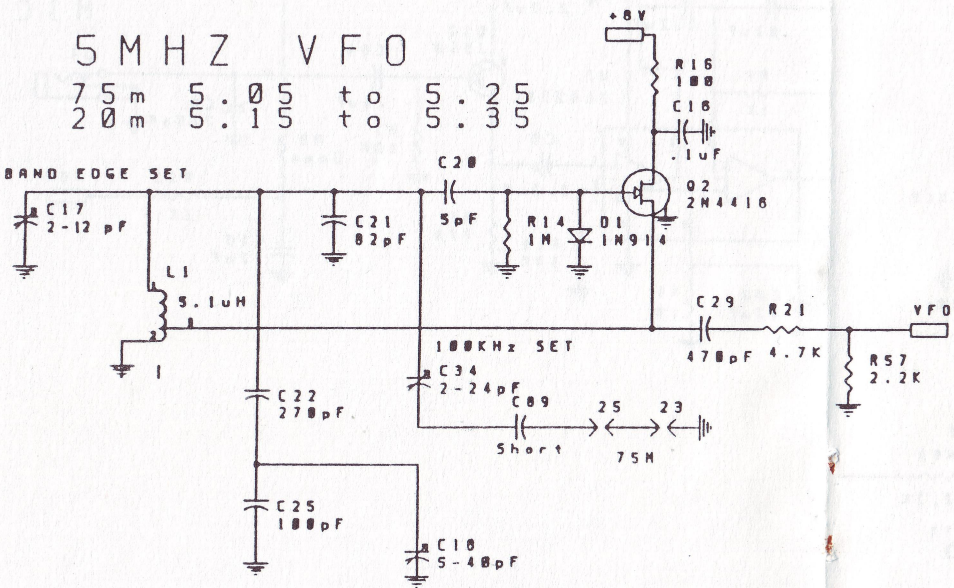


9MHz BFO

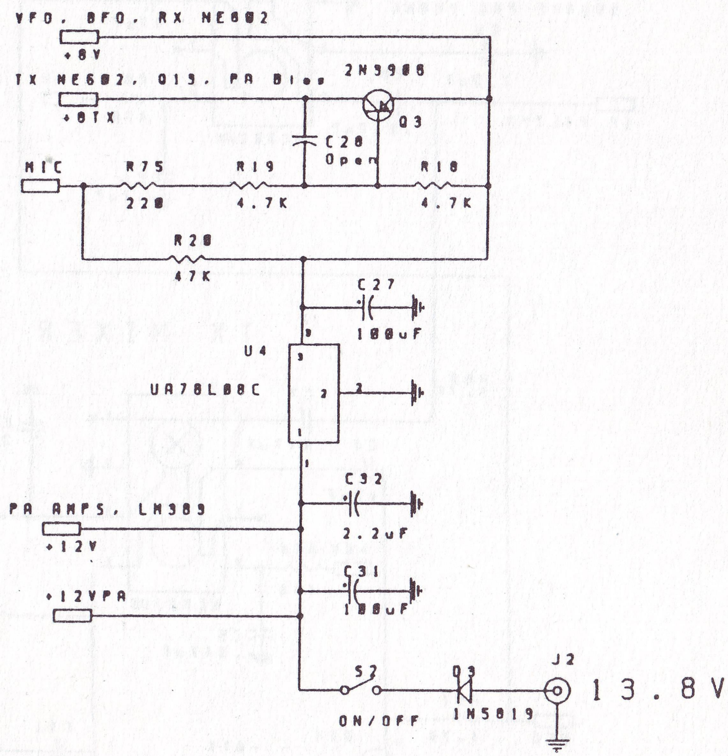


5MHZ VFO

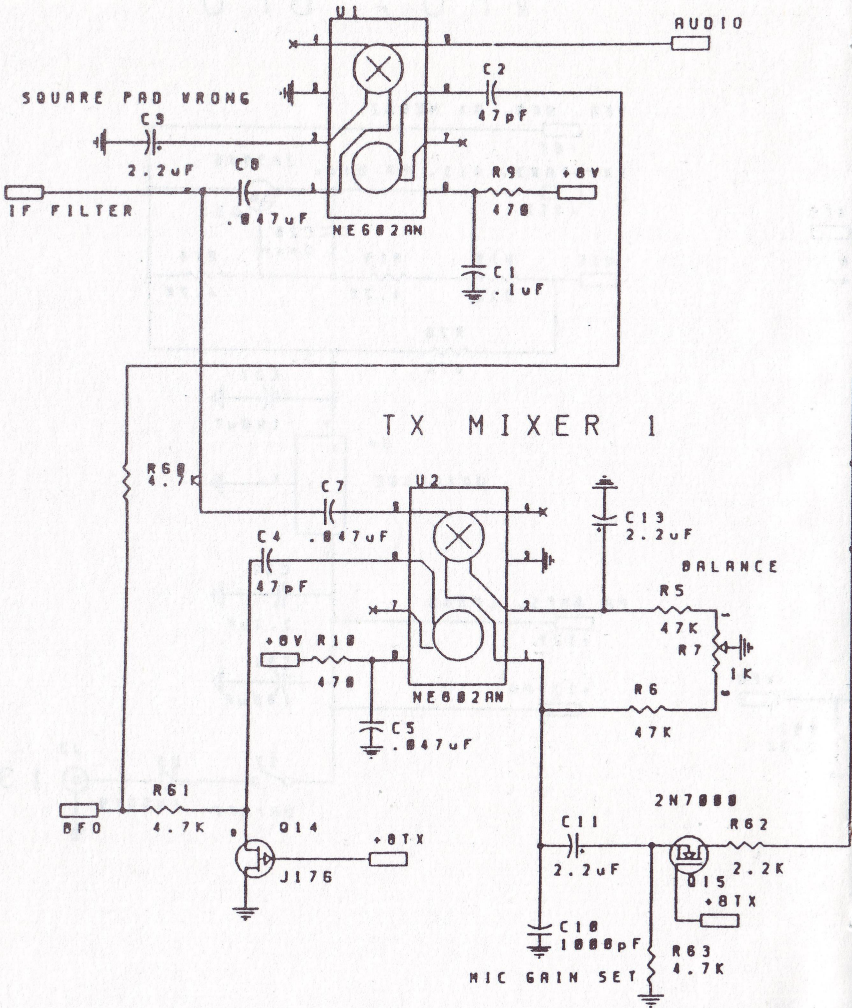
75m 5.05 to 5.25
20m 5.15 to 5.35



VFO, BFO

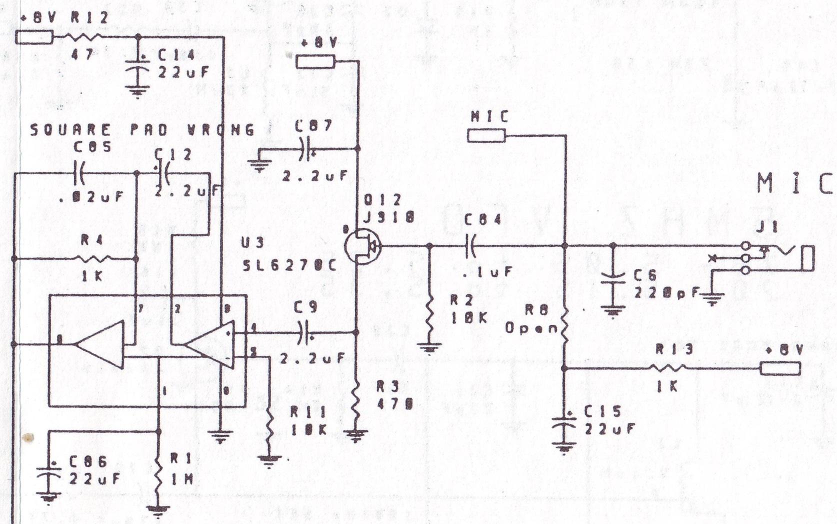


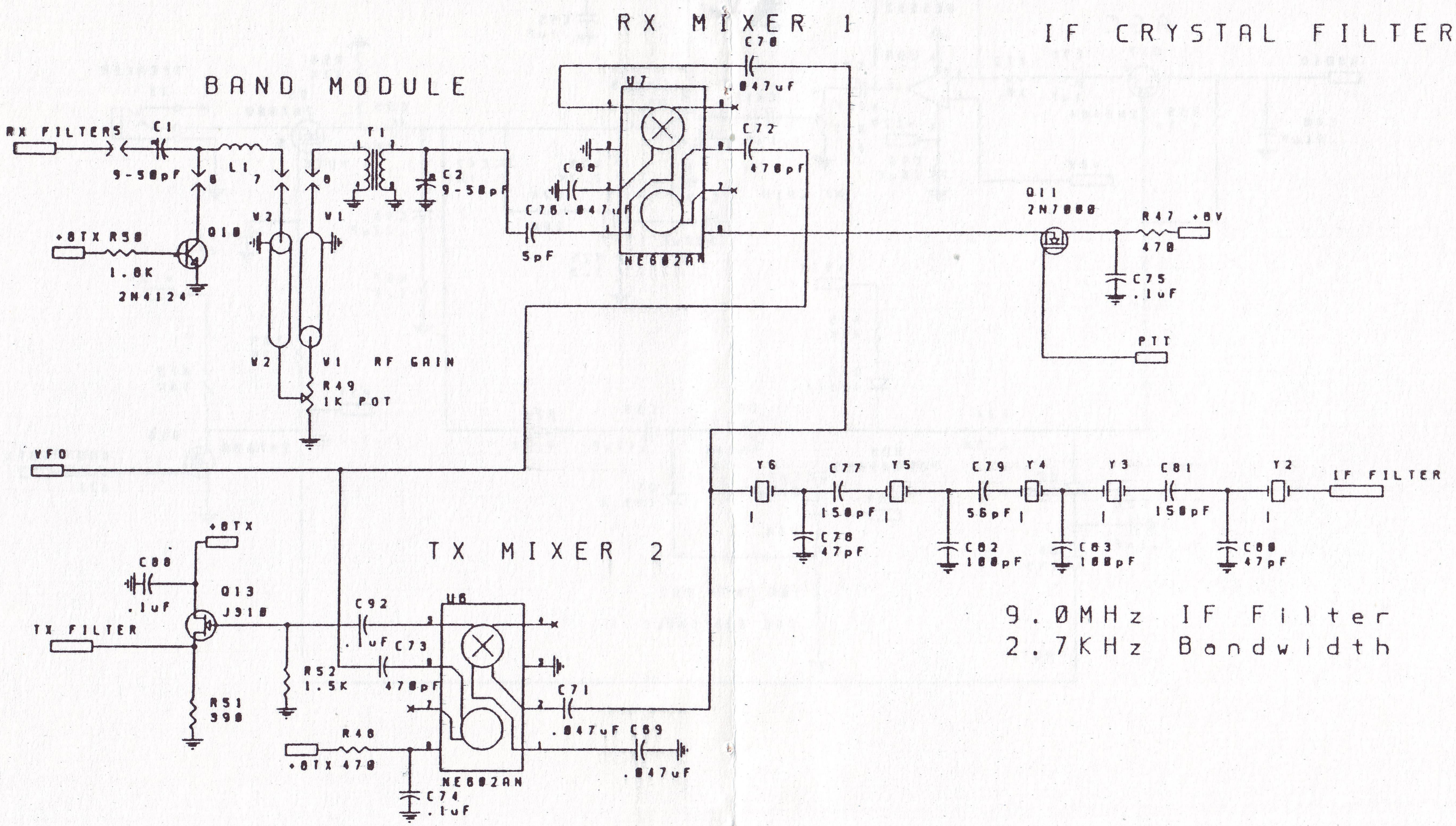
RX MIXER 2



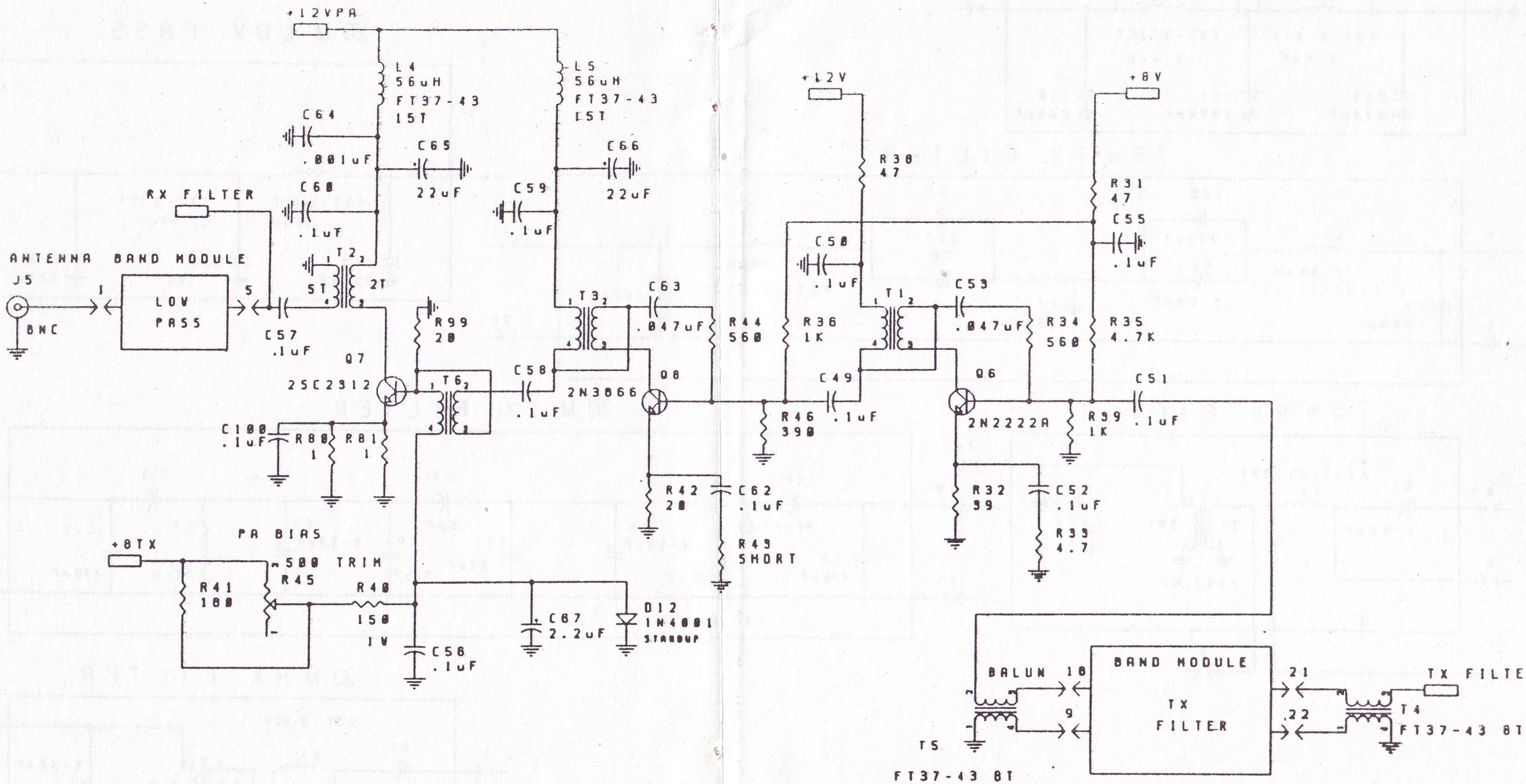
PRODUCT DETECTOR

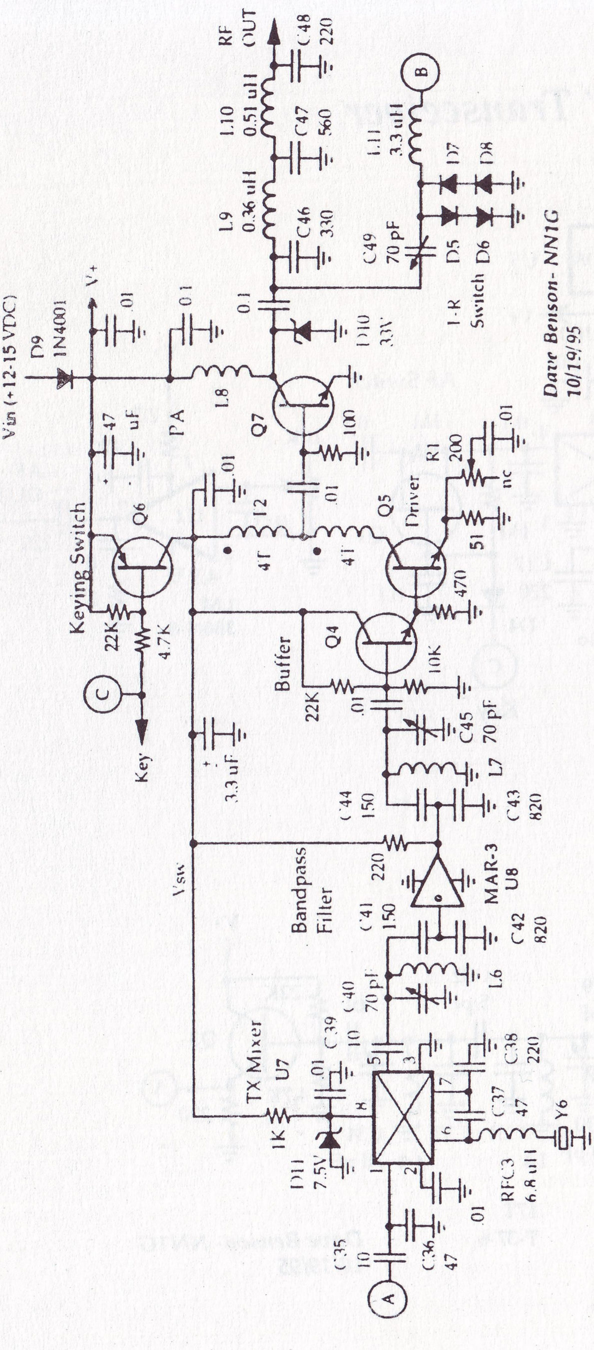
GAIN CONTROLLED MIC AMP



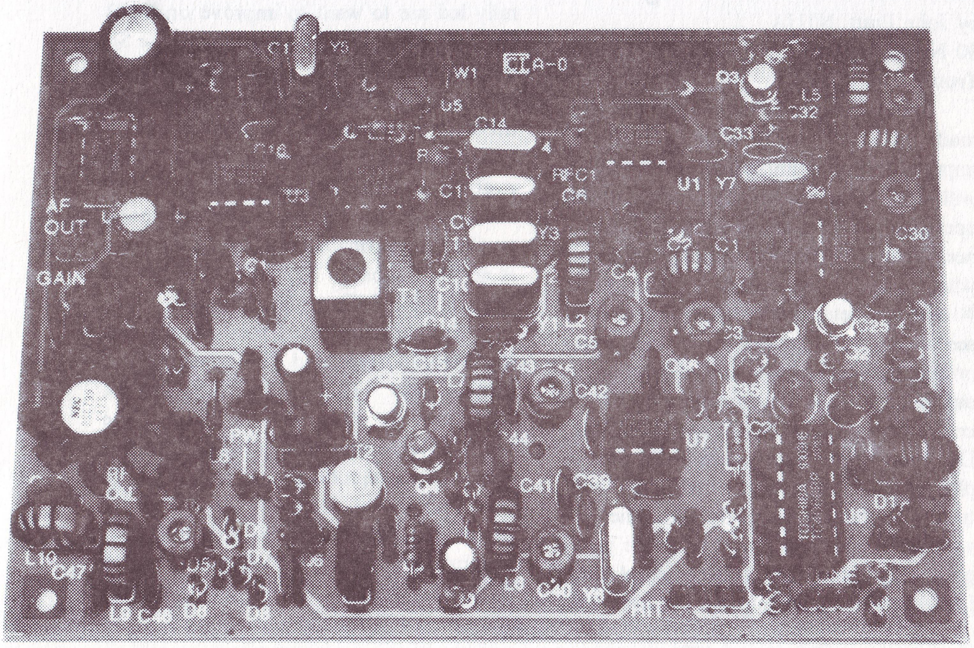

BAND MODULE
RX MIXER 1
IF CRYSTAL FILTER
TX MIXER 2
RX FILTERS
C1
9-50pF
L1
T1
C2
9-50pF
+8TX R50
1.8K
2N4124
Q10
V2
V1
RF GAIN
R49
1K POT
VFO
U7
C70
.047uF
C72
470pF
C68
C76 .047uF
5pF
NE602AN
Q11
2N7000
R47
+8V
470
C75
.1uF
PTT
Y6
C77
Y5
C79
Y4
Y3
C81
Y2
IF FILTER
150pF
56pF
C78
47pF
C82
100pF
C83
100pF
C80
47pF
+8TX
C88
.1uF
Q13
J310
TX FILTER
R51
390
C92
.1uF
C73
470pF
R52
1.5K
U6
C71
.047uF
C69
.047uF
R48
+8TX 470
C74
.1uF
NE602AN
9.0MHz IF Filter
2.7KHz Bandwidth

POWER AMPLIFIER





Vin (+12-15 VDC)
D9
1N4001
V+
.01
47
uF
PA
0.1
L8
Q7
100
.01
D10
33V
0.1
L9
0.36 uH
C46
330
C47
560
L10
0.51 uH
C48
220
RF
OUT
C49
70 pF
T-R
Switch
D5
D6
D7
D8
L11
3.3 uH
B
Dave Benson- NN1G
10/19/95
Keying Switch
Q6
22K
4.7K
C
Key
3.3 uF
T2
4T
4T
Q5
Driver
R1
200
nc
.01
51
470
Buffer
Q4
22K
10K
.01
C45
70 pF
L7
C44
150
C43
820
Vsw
220
MAR-3
U8
Bandpass
Filter
C41
150
C42
820
L6
C40
70 pF
C39
10
TX Mixer
U7
.01
C38
220
C37
47
Y6
1K
D11
7.5V
RFC3
6.8 uH
.01
C35
10
C36
47
A



Green Mountain CW Transceiver by Dave Benson, NN1G

Dave Benson, NN1G has designed a whole series of CW transceivers for the QRP CW enthusiast. Pictured above is the circuit board layout of his latest design. Dave's first design was the NN1G for 20 meters that appeared in the January 93 issue of QRP Quarterly, published by the ARCI. That radio was later kitted by Danny Stevig of Dan's Small Parts, and boards were made available from Far Circuits. The transceiver was on two boards, and was very popular as it was one of the first superhet transceivers to be made available at a cheap price.

The next rig that appeared in the Benson series was the New England 40-40, which was a club project for the New England QRP Club, and the idea of a club transceiver was modeled after the success of the NorCal 40. The name 40-40 came from the fact that it was a 40 meter rig and the cost was $40. You could also order a 30 meter version, called the 30-40. The New England Club only did 100 of the kits, but the demand was so huge that Dave started his own company, Small Wonder Labs to produce the 40-40 and 30-40 kits. He wrote an article for QST that caused his orders to go through the roof. He later added an RIT kit and a case and knobs package to the basic kit.

The 40-40 had a 2 pole crystal filter, no RIT or AGC in the basic unit. Dave was deluged with requests for another design incorporating these features and an improved crystal filter. He has done so, and the Green Mountain Transceiver is the result. All of the parts are extremely high quality, and the board is as good as they come. I especially like the idea of using the molex style plugs for the control connections. It makes the board much easier to troubleshoot. I first saw this in the Epiphyte I designed by Derry Spittle, VE7QK, and think that it is an idea that is well worth using. Ordering information for the Green Mountain Transceiver is page 65.

The Sierra - A Learning Tool

by John Pratt, N1UA
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Numerous people have stated that they made modifications to their QRP rigs to improve and/or optimize performance along with advancing their understanding of the operation of the various circuits. I had a need to improve the 30 meter output power whcih was 1.2 Watts vs. 2.3 Watts for the 40 and 20 meter bands. Also, I wanted to see what kind of general power output improvements could be made, if any , without making major modifications to the Sierra circuitry. I have Jim Pepper's (W6QIF) DC Transceiver which puts out a good 4 plus watts. I seem to get more QRP contacts with this rig than I do with other 1-2 watt rigs. Jim says that it could be partly psychological and partly band conditions. I tend to agree with him but I will go with what works best for me - Hi. THis naturally led me to want to improve on the 2 watt average power I now get from the Sierra bands that I have. My bands of interest are the 40/30/20 meter bands. Being a life-long experimenter I wanted to try the suggestions made by others in QRPp. However, I also wanted to understand the "why" along with the "how". After all, once you're hooked on QRP building, then there is no turning back. My order is in for the NorCal QRP SSB rig, the Cascade.

The circuitry that I focussed on was the Sierra Driver and Power Amplifier/ Output Filter. This consistent with work performed by other club members. The transmitter driver and power amplifier schematic is reproduced in Fig. 1.

The initial Sierra 40/30/20 meter driver and PA/output filter operating conditions for a Vcc = 12 Vdc are given in Table 1.

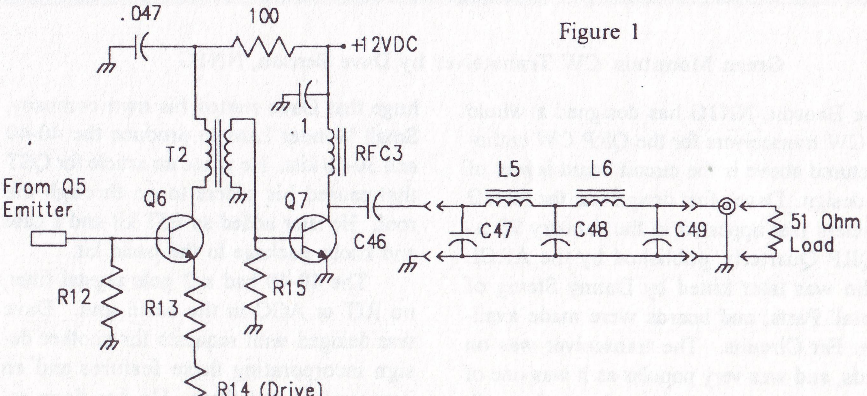


Figure 1

Table 1

Band	Q6 C	Q7 B	Q7 C	C47	C48	C49	Output Power
40M	15V	1.8V3	30mA	37V	38V	30V	2.3W
30M	15V	2.0V	290mA	32V	30V	22V	1.2W
20M	13V	1.8V	300mA	34V	32V	30V	2.3W

Note: All voltages are peak-to-peak readings.

Table 2
Modified Sierra 30 Meter Operating Conditions

Line #	V Q6C	V Q7B	Q7 mA	IcC47V	C48V	C49V	Pout W	Eff %
1	15	2.0	290	32	30	22	1.2	34
2	15	4.0	320	33	30	25	1.6	42
3	14	4.0	330	40	42	32	2.6	65
4	14	4.0	380	40	50	36	3.2	70
5	15	4.0	460	42	54	40	4.0	72

Note:
All Lines: Vcc = 12VDC, T2 Ratio = 12T Pri : 3T Sec
Lines 1, 2 and 3: L5 = 16T, L6 = 16T
Lines 1, 2, 3 and 4: C47 = 330pF, C48 = 560pF, C49 = 300pF
Liens 4 and 5: L5 = 15T, L6 = 16T
Line 5: C47 = 110pF

Table 3
Breadboarded 30 Meter Operating Conditions

Line #	V Q6C	V Q7B	Q7 mA	IcC47V	C48V	C49V	Pout W	Eff %
1	16	4.0	250	33	42	30	2.3	75
2	18	5.0	330	40	36	34	2.89	73
3	15	4.0	320	32	52	36	3.24	84
4	17	4.0	400	44	56	40	4.0	83

Notes:
All lines: Vcc = 12VDC, T2 Ratio = 12T Pri : 3T Sec
Lines 1 and 2: L5 = 16T, L6 = 16T
Lines 1, 2 and3: C47 = 330pF, C48 = 560pF, C49 = 330pF
Line 3: L5 = 15T, L6 = 16T
Line 4: C47 = 110pF

These results are for power saturated conditions where the PA drive potentiommeter R14 is just backed off from maximum power out as seen on a scope across a 50 ohm resistive load. Note that the only initial questionable condition is for 30 meters. This further apparent when the efficiencies are considered: 40M = 57%, 30M = 34%, 20M = 63%.

The 30 meter transmitter tuned circuits were carefully peaked and in the process it was found that only one peak was found on both L3-C33 and L4-C36 tuned circuits. There should be two peaks when tuning either C33 or C36. A signal generator and a scope with high impedance probe was used to determine that each of the above tuned circuits was resonating too low. So 5 turns were removed from both L3 and L4. This allowed two peaks to be found on 30 meters, whcih now peaked identically to the 40 and 20 meter boards. The Sierra 30 meter Voltage (P-P) of Q7 B increased from 2.0 V to 4.0 V, resulting in a slight improvement in power output and efficiency: 1.6W and 42% efficiency. The resultant operating conditions are given in Line 2 of Table 2.

All of the Sierra modifications will be incorporated in Table 2 along with the appropriate notes so that before and after comparisons can be easily made. This includes the original Sierra 30 meter operating conditions (line 1). The same procedure will be followed with the breadboard data (BB).

At this point it was decided to try some of the suggestions given by others in QRPp along with some ideas of my own. The

best way to do this was to duplicate the Sirra driver, power amp, and output filter on a Breadboard (BB). This is much safer than removing components from the Sierra unit. Included on the BB was a crystal oscillator with an adjustable output voltage to drive the Sierra circuitry. The 30 meter circuitry was breadboarded because it still needed improvement especially in the efficiency area. Most improvements, if any, should also work for 40 and 20 meters.

The breadboard Q6B driving signal was set identical to the Sierra drive (4V peak-to-
peak) along with Vcc = 12VDC. The coils and capacitors were identical except for the output filter capacitors which were silver micas (what I had on hand). The following breadboard results were obtained. See Table 3, Line 1.

The output power is almost one watt higher (2.25W vs. 1.6W) on the breadboard circuit than the Sierra rig with less breadboard current being drawn (250mA vs. 320mA) so the breadboard efficiency improves (75% vs. 42%). Now the task is to get the Sierra rigoutput and efficiency up to the breadboard values. The first area to check is the Sierra output filter whcih has ceramic capacitors. The Sierra output filter on the plug-in board was connected to the breadboard with four one inch #16 stranded wires to replace the breadboard outpout filter. The results were very poor with the output less than half a watt. The Sierra output filter ceramic capacitors were inserted in the breadboard output filter one at a time with the same results; loss of power and lower efficiency. Next, C47, C48 and C49 in the Sierra 30 Meter plug-in board were replaced with silver mica capacitors. The results were: VC49 = 32V P-P, 2.6 W, Q7C I = 330mA with an efficiency of 65%. (See Table 2, line 3)

It is evident that any losses in the path of he output filter circulating currents (long lead resistance losses and component I^2R losses) really affects power output and efficiency. Imagine the problems that Wayne had in designing the Sierra plug-in boards and associated PA circuitry so that the Sierra rig works as well as it does on all bands. My breadboard unit output filter performed well because of short ground paths, the use of silver mica capacitors, and no band changing.

Changing L5 and L6 (output filter coils) from T37-2 (16 turns) to T50-6 (16 turns) on the breadboard made no meaningful difference in operating conditions. Both T37-2 and T50-
6 (16T) are approximately 1.02uH according to the torroid charts in QRPp Dec. 1993.

The effects of changing T2 parameters will now be analyzed to see if any optimization can be obtained. It is realized that to cover the frequency range from 160 to 10 meters, a compromise coil winding and core will have to be used. This is what Wayne referred to in his rig description. In my case where my interest is mainly in the 40/30/20 meter bands, optimization in the 30 meter band is expected to be sufficient. Changing T2 secondary from 3 turns to 4 turns caused a slight decrease in Q7B voltage whch slightly decreased output power. I suspect that T2 primary had additional loading because the primary voltage also decreased slightly. The winding configuration (Pri 18T : Sec 5T) suggested by Dave Meacham, W6EMD (2) was now tried. The same loading problem as above was found. Reducing the secondary turns from 5 to 4 turns reduced the loading so the power out was essentially the same as the power out obtained with the original T2 winding. My feeling is that 160 and 80 meter operation would be better with this winding but I don't know about 10 meters. For now I will stay with the original T2 coil. In addition I found that reversing the T2 secondary had no meaningful effect on output power and waveshape on Q6 Collector. In one phase there was another waveform (mostly third harmonic) riding on the primary (desired) waveform. The

PA output waveform was not changed in any meaningful way at least after being filtered by the low pass output filter.

The best phasing was when the primary winding connection to Vcc and the secondary winding to ground were on the same side of the toroid. Also, connecting a small mica trimmer capacitor (approximately 50pF) across the secondary and adjusting for the cleanest waveform on the collector of Q6 seemed to have a small effect on waveform and stability but nothing meaningful. This result may be different at higher power and higher frequencies where the Q7 base inductance may effect stability.

Next, changing Q6 from the 2N2222A to a 2N2219A did not give any meaningful improvement. This also held true when Q6 was forward biased to about 30mA DC.

Now it is worth while to evaluate the output low pass filter for harmonic removal. Not having a spectrum analyzer, I have to use indirect methods to estimate if unwanted harmonics may be a problem. The first method is to observe the waveshape at the PA collector (C47) with my 20MHz scope. On bands below 20MHz the collector waveshapebegins to look triangular rather than sinusoidal when driven to maximum power out. The symmetry indicates that some third harmonic energy is being added to the fundamental (the waveshape is symmetrical about the vertical axis). On C48 (the middle filter capacitor) the waveshape looks more sinusoidal with some peak-to-peak amplitude increase. On C49 (the output capacitor) the waveshape looks like a nice clean sinusoid with a decrease in peak-to-
peak amplitude.

The second method is to connect a signal generator with an approximate 50 ohm output impedance and constant amplitude to the input of the low pas filter at the collector (collector circuit disconnected) and a 50 ohm resistive load to the filter output. connect the scope along with an RF diode voltmeter at C47, C48, and C49. The voltmeter is a check on the scope to make sure that the scope's frequency response does not give misleading results. it is realized that the voltmeter responds to total amplitude, fundamental and harmonics so care must be taken in making comparisons. Even so with some experience the RF voltmeter alone can be meaningful tool for a beginner with little or no test equipment - see Sierra manual for examples. I also hear that Jim Pepper, W6QIF, may have an RF signal generator in the works, (3). I found that I needed a fairly large signal amplitude 3 to 5 volts peak-to-peak) in order to get a usable result over a wide frequency range. I was able to do this because I had a breadboard version of Doug DeMaw's, W1FB, Multipurpose Instrumentation Amplifier. (4) This amplifier has roughly 40 dB gain, is reasonably flat from 250kHz to 80MHz, and ahas 50 ohm output impedance. The frequency of the 30 meter lowpass filter showed a null (approximately zero volts on the scope and the RF voltmeter they tracked), at 19.3 MHz on C47, null at 18MHz on C48, and a null at 16MHz on C49. these results seemed very satisfactory to me even though I realize that output can rise again beyond the nulls. Again note that the approach used here is on learning and understanding what is going on. It would be nice to run this response on a computer and plot the results. I did some of this on a hand calculator as described under "Ladder Networks" in recent editions of the ARRL Handbook. This step-by-step circuit simplification and impedance transformation is somewhat tedious by hand, but very simple on the computer whcih I do not have. You can not beat the "by hand" method as a learning device especially if you want to try and increase power by changing the impedance tht the PA collector sees; i.e. transform the 50 ohm load to a lower PA load than is now seen, transistor and PA drive willing.

Before trying to increase power, I

should goin the group and apologize to Wayne Burdick, N6KR, for messing with a nice conservative design that gives 2+ watts with practically no heating of the transistor and good stability. My excuse, of course, is that this is a learning exercise. This allows me to try to optimize and maybe give an extra nudge where I may squeeze an extra watt or so without much effect on transistor heating or circuit stability.

My literature research (5, 6, 7) indicates attention should be paid to the PA and Driver transistors, PA drive voltage, PA load/output filter and associated factors such as heat transfer, stability, saturation, and harmonic reduction. Most of the references available to me were created wholly or in part by Doug DeMaw, W1FB and he should be given full credit for advancing the home brewer's education and enjoyment - God Bless!

Again, the breadboard is the ideal tool for investigating the above areas to optimize for a pwer increase. The meaningful maximum 2N3553 ratings are Vcdo = 40 Vdc, Veb = 4.0 Vdc (forward and reverse), IC = 1.0A Dc, Pd = 7.0 W and output capacity = 8pF. Both the 30 meter breadboard and the Sierra rig operate conservatively within these ratings as theabove operating conditions show (see Table 2, Line 3 and Table 3, Line 1). the parameters that I watch while experimenting were Veb, Ic, and Pd. A conservative PA design is to operate the collector plate dissipation at 50% of maximum. The approximate Sierra PA collector dissipation is Pd act = Pin - Pout. this is Pd act =3.48W – 2.56W = 0.92W. This assumes no losses in the output filter. Even with the approximations there is still plenty of room to experiment expecially as the PA transistor was barely warm to the touch over a reasonable time frame. The breadboard characteristics were better because it had a better efficiency.

The simplest parameter on the breadboard to test was the PA drive because the drive to the Q6 driver was adjustable. The results obtained were 2.89W power out with Q7 B peak-to-peak voltage equal to 5.0V. (See Table 3, Line 2). these results could not be obtained with the Sierra unit because the maximum drive did not go that high (5V P-P). Modifying the driver and T2 to accomplish this will be held in reserve in the event other simpler methods cannot be found.

The usual output filter tuning techniques of compressing and spreading the turns of L5 and L6 was the next thing to try on the breadboard. Compressing L6 turns caused a slight increase in output power while spreading L5 turns caused a slight decrease of output power. However, spreading the L5 turns had the best power increase. L5 turns were deceased to 15 turns and the results recorded. (See Table 3, Line 3.) There was approximately 1 watt of power increase for a total of 3.24 watts with an efficiency of 84%. This seems to indicate a close to optimal match between the PA collector impedance and the load presented by the output filter. The same thing was doen on the Sierra rig with also close to 1 watt power increase to a total of 3.2 watts with an efficiency of 70% (see Table II, Line 4). However, I still want to know "why" so the next step is to analyze the impedance transformation through the low pass output filter to see what impedance the PA collector actually sees.

The component impedances of the low pass output filter for 30 meters and their separation into two PI filters is shown in Figure 2. Note that C48 is separated into two parts so the impedance transformation can be more readily understood. This low pass output filter is a slight variation of the one-half wave filter which repeats the load and has all the component impedances identical. The slight increase in inductor impedance gives an increase in Q and makes iteasier to fine tune the filter (compressing and expanding inductor turns spacing on the toroid) so that internal capacitances such as Ci (collector capacitance)

Figure 2

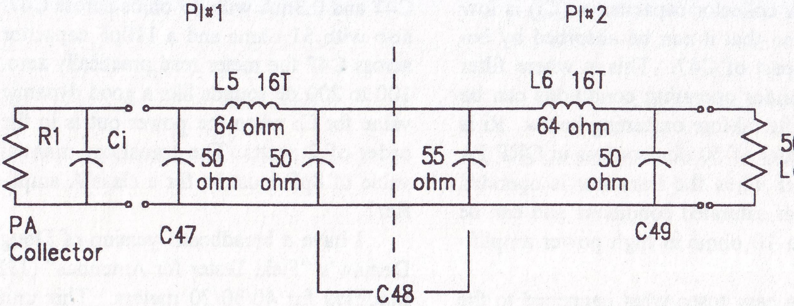
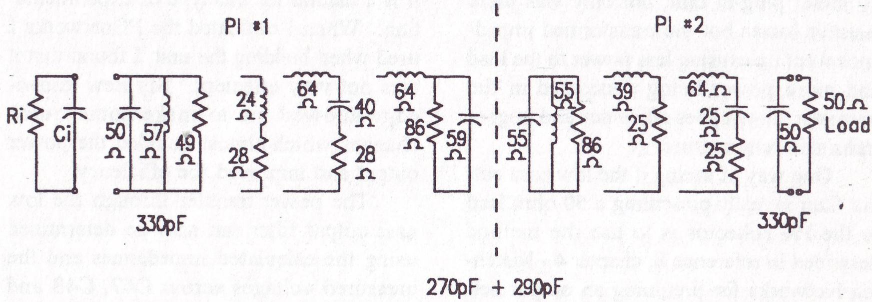


Figure 3



can be absorbed as part of C47. (8, 9, and 10) Q gets critical when impedance transformation ratio is low. the parallel toseries circuit conversion and its reverse is the way filter computer design is usually performed. The computer advantage is that a small change can be made and the new results quickly obtained. However, if you are like me with only a hand calculator and don't mind the number crunching, quite a bit can be learned about the "why" which is what I am after. An example of this technique on the above low pass output filter is shown in Fig. 3.

The 50 ohm load impedance is transformed through PI filter #2 to present a resistive value of approximately 86 ohms to the output side of PI filter #1. This filter in turn transforms the 86 ohm resistive load down to a reistive value of approximately 49 ohms which becomes the load that the PA collector sees. It should be realized that what has been shown is the "one way" impedance transformation from 50 ohms on the right through two PI filters to present an approximate 50 ohm load to the PA collector. It does not show the effect of the collector's resistive impedance (Ri) on the above impedance transformation. This effectgets complicated as can be seen in references 9 and 10. Suffice to say that if the circuit q stays above certain limits, the above transformations hold true. Otherwise, the output power and PA efficiency would decrease significantly. the relationship between Ri and the transformed load impedance is the main factor controlling output power assuming adequate PA drive and gain. Some changes will be made below to the transforming impedances to see

if the output power can be increased. Generally PA collector capacitance (Ci) is low enough so that it can be absorbed by becoming part of C47. This is where filter tuning under operating conditions can be meaningful. More on tuning below. Ri is in the order of 50 ohmsor less in QRP PA amplifiers when the transistor is operated in or near saturated conditions and can be less than 10 ohms in high power amplifiers.

It is easy tosee what happened to the transformed load impedance when lossy capacitors (I^2R losses) as found in the above 30 meter plug-in unit; not only was there resistive losses but the transformed impedance went up causing less power to the load and more power being dissipated in the transistor. down goes efficiency and upgoes transistor temperature.

One way of seeing if the low pass output filter is really presenting a 50 ohm load to the PA collector is to use the method described in reference 8, chapter 4 - Matching Networks for pretuning an output network using a 50 ohm impedance bridge and a low level RF signal source. First remove all power from the unit. Second, temporarily connect a 50 ohm resistor across C47. Third, connect the output of the 50 ohm impedance bridge to the low pass output filter load teminals and its input terminals to the low level RF source.

First, connect the output of the RF signal source (10.1MHz) across the bridge and adjust its RF output for maximum deflection on the bridge meter (1.0mA in my case). Second, remove the Sierra plug-in unit from the rig and connect a 51 ohm resistor across C47. Third, connect the bridge output across C49. Observe the degree of nulling. There probably will be about 1/4 scale deflection on the bridge meter because the collector capacitance (Ci) and any stray capacitance are missing. In my case the meter read 0.15mA. Compressing L6 turns reduced the meter reading to 0.08 mA. Adjusting L5 had no real effect. For comparison I read 0.2mA with 100 ohms across C47 and 0.3mA with 33 ohms across C47. also with 51 ohms and a 110pF capacitor across C47 the meter read practically zero. 100 to 200 pF sounds like a good dynamic value for Ci when the power out is in the order of 2 watts. The transistor manual value of 8pF must be for a class A amplifier?

I have a breadboard version of Doug Demaw's "Field Tester for Antennas" (11) modified for 40/30/20 meters. This unit has a built-in RF source and 50 ohm impedance bridge along with being tuneable. It is a natural for this type of experimentation. When I evaluated the PI networks I used when building the unit, I found that it was not very effecient. My new knowledge allowed me to make some quick changes which almost doubled the power output and improved the efficiency.

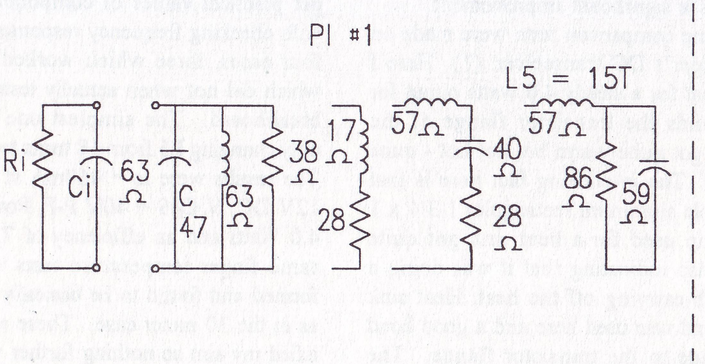
The power transfer through the low pass output filter can now be determined using the calculated impedances and the measured voltages across C47, C48 and C49.

P = VP2/2R: P C47 = 2.72W, P C48 = 2.56W, P C49 = 2.56W

The loss of power going through PI #1 network (0.16W) can be accounted for by the filtering of the harmonics by PI #1 filter. Power transfer through PI #2 filter shows no meaningful losses indicating tht the component losses are very low (bless those silver micas). The relationship Pload = (I^2)(Rload) and Pcollector = (I^2)(Ri) can be used to determine that Ri = 14 ohms. This lower than I would expect for a QRP PA but it could account for theefficiencies up in the 70% range. It also indicates that the PA drive is strong enough so that the transistor peak currentis near saturation.

This operating condition is good for taking the next step; namely changing the impedance transfer throught the low pass output filter so tht the PA collector sees a load impedance of approximately 30-40 ohms. the simplest initial approach is to

Figure 4



leave PI #2 alone and see if PI #1 can transfer 86 ohms to about 35 ohms. The new PI #1 diagram is shown in Figure 4.

The breadboard low pass output filter circuit was changed to match the PI #1 circuit shown in Fig. 4. L5 = 15T, C47 = 110pF. Also the PA collector was disconnected from the lowpass output filter and a 33 ohm resistor placed in parallel with C47. Now the "Field Tester for Antennas" was connected as above and the bridge meter observed to read 0.3mA. Several capacitors were paralleled across C47 one at a time until a 330pF capacitor was found to give a null of 0.05mA. this was evidence that the 110pF along with Ci was a good ballpark capacity to start operational tuneup. The test equipment and the 33 ohm resistor were disconnected, PA collector reconnected and power applied with PA drive set for just discernible power output across a 50 ohm resistive load. Adding additional capacity to the 110pF (C47) capacitor did not give any increase in power so C47 was left as is. The PA drive was now increased until the output across the 50 ohm load was 40V peak-to-peak which is equivalent to 4 watts. PA Ic was 400mA giving an efficiency of 83%. Operating condition values are shown in Table 3, Line 4. The PA transistor felt fairly warm to the touch after about 30 seconds of steady operation. Now the same low pass output filter was set up on the Sierra plug-in unit, the unit installed in the rig, and the same procedure used to bring up output power to the same value (4 Watts), PA Ic was 460mA giving an efficiency of 72%. Operating condition values are shown in Table 2, Line 5. The PA transistor was beginning to get hot after 30 seconds. The operating conditions of Table 2, Line 4 mode made the transistor fairly warm after 30 seconds. When making this heat test my finger was on the top body of the transistor.

When I moved my finger to the black fins of the star heat sink I could barely feel any heat even when the top of the body was getting hot. When I put thermal compound on the transistor sides I found tht with 4 watts output the transistor top body got fairly warm but not hot after 30 seconds. The fins of the heat sink still did not get very warm. A quick test was made at 4 watts sending just dashes at about 20 wpm for 1 minute. the transistor body top got quite warm but the system was still useable. Some days later I replaced thestar heat sink with a top hat heat sink that fit snugly around the thermal compound coating on the transistor body. On steady state testing the transistor body and fins got quite warm after 45 seconds vs 30 seconds for the star heat sink. Sending steady dashes for 1 minute caused the body and fins to

get fairly warm but very useable. This heat sink was a significant improvement.

Some comparison tests were made on Jim Pepper's DC transceiver. (1) Here I found that for a steady 4.0 watts ouput for 30 seconds the transistor flange of the IRF510 got quite warm but not hot - quite useable. The interesting fact here is that the simple aluminum rectangular 1-3/4 x 1 inch strip used for a heat sink got quite warm also indicating that it was doing a good job carrying off the heat. Heat sink compound was used here and a good bond was made to the transistor flange. The same general heat sinking method using a grounded copper strip was used by Dave Meacham, W6EMD in his 5 Watt mod for the NorCal 40. (2) I plan on more on-the-air testing at both 3 and 4 watts using the finger test to find my temperature comfort zone. Now with 4 watts I can start working on my psychological powerbarrier as well.

The same power output enhancement procedure that was performed on the Sierra 30 meter plug-in low pass output filter was now repeated on the Sierra 40 meter plug-in board. This included all the above analysis and breadboard testing of results before they were incorporated in the 40 meter plug-in unit.

The low pass output filter values used in the original 40 meter unit present an approximate 50 ohms load to the PA collector and transfers 2.3 watts of output power to the 50 ohm resistive load. The same procedure of only modifying the PI network components closest to the PA collector was tried again. The intent is to transform the resistance (68 ohms) that appears across C48 down to 30 to 40 ohms across C47 which is the load the PA collector sees. As stated before there are numerous combinations of components that theoretically will achieve this result. However there are practical limits on Q that need to be satisfied in order to achieve the above impedance transformation. (10)

Computer programs iterate values to get practical values of components along with checking frequency responses. I tried four cases, three which worked and one which did not when actually tested on the breadboard. The simplest one required only changing L5 from 18 turns to 16 turns. The results were Ic = 460mA at a Vcc of 12V DC, V C49 = 40V P-P, Power out = 4.0 Watts and an efficiency of 72%. The same finger temperature tests were performed and found to be basically the same as in the 30 meter case. These results satisfied my aim so nothing further was done.

Finally, I realize that some of my comments are subjective and based on information that is not complete and/or fully understood by me. Therefore, some folks will take exception and disagree. I think tha is fine as long as they let our editor know so he can print corrections and clarifications. I want to learn and this is a good way for all of us to upgrade our knowledge. 72-73, John Pratt, N1UA

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NorCal QRP Club "QRP to the Field Contest Results

by Bob Farnworth, WU7F
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I had a ball, I hope you had a lot of fun doing the contest. Fifty logs were sent in for a contest that was hatched late December and early January. It was a fantastic turnout for such short notice. Field Day and QRP Afield also had good turnouts from the QRP ranks. I believe it indicates a QRPer generally enjoys the field type operations, and for QRP to the Field, there were thirty-three stations out in the field. the roller coaster propagation conditions on twenty kept activity somewhat low, but forty was a hot bed of activity.

A total of 1115 contacts were reported. Over fifty percent of the entries used homebrew rigs, and a number of those were under 1 watt for the contest operations. Thanks goes out to the many home stations that provided contacts to those out in the field, among those were KP4DDB and W6UMP on CW, and KI6DS on SSB. The many expeditions, included the New Mexico group to Mount Baldy, the Texas group to Sugarloaf Mountain, and Utah group to Antelope Island in the Great Salt Lake. It was still cold in many parts of the country for the first of April, but Craig, WB3GCK, in cold, cold Pennsylvania, stuck it out and made a big score of 2070 points to take the lead in the contest. Next year, a few changes are in the works and notice of the contest will be made early enough to catch the newsletters and magazines. Thanks toall that participated, I look forward to working you on Field Day or the "QRP Field Contests". 72, Bob, WU7F

NorCal QRP Club
Spring QRP to the Field
April 1, 1995 Contest Results

Call	QTH/SPC	Q's	Score	Rig	Power	ANT
1 WB3GCK	Field/PA	46	2070	40-40	950mW	Inv. V
2 KC6EIJ	Field/CA	37	1665	NC40	1W	Dipole
3 KI6SN	Field/CA	35	1575	NC40	1W	Inv. V
4 AA6AV	Field/CA	29	1305	40-40	950mW	1/2Sloper
5 KK6IU	Field/CA	76	1215	NC40A		Skelton
(+KI6PR & AC6LS				QRP+	5W	Cone
6 N6WG (+WA6NAE)	Field/CA	42	945	NC40A	2W	Dbl Loop
7 W6EMT (+WU7F)	Field/WA	34	683	HBW6EMT	5W	Yagi
8 K4XY	Field/VA	43	645	FT-757	5W	Dipole
9 AB6NZ	Field/CA	41	615	Delta II	5W	R7 Vert
9 W6UMP	Home/CA	41	615	Sierra	1W	Zepp
WA0RPI	Field/MN	23	518	HW9	3W	L.W. Kite
AF5U	Field/AZ	23	518	OHR Cl.	5W	Dipole
WA2CRQ	Field/CA	22	495	HW8	2W	Inv V

K6BSU	Field/CA	21	473	HBK6BSU	3W	Zepp
W5ORM	Field/TX	15	450	FT757	500mW	AV5Vert
NA5K (+ W2LQ K5JHS, N5OSG, K5JHP)	Field/TX	29	435	Argo II	5W	Dipole
K2SJB	Home/NY	29	435	NN1G	1W	
KG0TW	Field/MO	27	405	TS430S	5W	Dipole
W5ES (AB5WB & AB5TZ)	Field/TX	27	405	MFJ9020 MFJ9420	4W	Inv. V.
KD4PUP	Field/VA	27	405	MFJ9040	4W	Dipole
KC1FB	Field/CT	9	405	40-40	<1W	E.F.Wire
NA5N	Field/NM	18	398	HB	5W	Dipole
KK7C	Field/UT	24	360	Argo509	4W	Wire
KG6VI	Field/CA	24	360	PM3-A	5W	
KD6ORH	Field/CA	23	345	MFJ9020	4W	Isotron
N4JEO	Home/VA	21	315	NC40A	1W	
N7ANT	Field/VA	20	300	FT757	5W	
VE7QK	Home/BC	37	278	Epiphyte II	5W	Inv. V
KI0G/Mobile	Mob/CO	10	225	NC40A	<5W	Hustler
KP4DDB	Home/PR	45	225	Argo II	5W	Yagi
KT3A	Field/PA	5	225	NC40	1W	Inv. V
N1IRZ	Field/NM	14	210	QRP+	5W	Dipole
VE7ZM	Field/BC	9	203	HB VE7ZM	5W	
VE7BLU (+VE7MAA & VE7BAY)	Field/BC	8	180	HW8	<5W	102' Cntr Fed Wire
AB5WT	Field/NM	8	180	NC40	2W	Zepp
WA4NID	Field/NC	8	180	Sierra	1.5W	Walkstik
KG7FC (+NZ7X)	Field/UT	7	158	K9AY	5W	Dipole
K5HT	Field/TX	9	135	MFJ 9017	4W	HB Vert
W6PRI	Home/CA	24	120		4.5W	
W6RCL	Home/CA	16	120	NC40	2W	HF2V
W0CH	Home/FL	12	120	TS530S	1W	Zepp
N6GA	Home/CA	15	113	Sierra	2W	Yagi/Dip
AB6SO	Home/CA	14	105	NC40	1.8W	Dipole
KB7BEJ	Home/AZ	18	90	Scout	5W	5BTV
VE7JO	Home/BC	12	90	VE7JO	5W	
WA6GER	Home/CA	15	75	FT301S	5W	5BTV
W3TS	Home/PA	5	75	W3TS	950mW	Inv. V
KB0HPH	Home/CO	8	60	HW-8	2W	
W6HPK	Home/WA	8	45	HB	4W	Zepp
WB6FZH	Home/HI	2	30	Cent21	5W	Vert

SoapBox: Bob and I had a good time setting up a big antenna (40M Dbl-Loop 113 ft. long), Now will know what to do when Field Day gets here. We will look forward to the event again next year. **N6WG (Dwight, WA6NAE)**. My first time to work QRP/P CW. I really had a good day. Nice people to chat with plus some DX (S92SS & XE1/AB5VI). **George, K5HT**. Conditons very poor here for a while but return to SF Bay area periodically. **Greg, WB6FZH/KH6**. First mobile QRP experience. Great event. Do it again. **Bob, KI0G**. Was it an April the first trick or what? Age is 72 and still get surprises. **Ken, VE7BLU**. Nice contest. Worked many new stations. 40M CW was great. **Bill W6PRI**. Station elevation was 10,700 feet. Worked coast to coast and 10 states. We had fun. Thanks NorCal for this contest. **Dave, N1IRZ/5 (South Mt. Baldy Expedition)**. I had an hour free over the contest period. I "sprung" antenna up in 12 minutes, down in about 8. It was worth it even for the short time. **Cameron, KT3A**. Conditons seemed very good - wish I had more time. **Cam, N6GA**. Cut it short due to wind and cold. However, had a great time. this would be fun to do again. Did not hear one other station working thsi contest, April Fool? **KG7FC (Greg, NZ7X) Antelope Island, Great Salt Lake.** Too bad contest ended at 2400Z. Using NorCal 40, terrific little radio. **Alan, W6RCL**. Forgot about contest. Next time I will be ready. **Vic, AB6SO**. My first QRP contest. Great contest, had fun. I can hardly wait for the next time. **JC, KC6EIJ**. All contacts on 14.060MHz with HW8 at 2W. **Jane, KB0HPH**. Thanks for contest, met some new people. It was a great day, 25 degrees and snowing. **Doug, KG0TW**. This was a lot of fun for this EE, age 67. **John, W5ORM**. Thanks to NorCal for a very nice contest. Honey-dos and work call-ins should have been multipliers!! **Rus, KB7BEJ.** Inverted V on protable mast, battery operation with solar panel. **Richard KI6SN.** Call it spring, but it was winter cold. Thanks to NorCal for fun event. **Jim KC1FB**. Great test, we kept the rules and had fun. **Jim, KK7C**. Total time two and half hours, set up in back yard. **Floyd, K6BSU**. I really wanted to give the NC40A a workout. Nice impression when you can tell another station you're running 1 watt from homebrew rig and carry on a long qso with solid copy. **Robert, N4JEO**. Backpack field day? Heard about QRP to the Field, perfect practice. **Peter, AA6AV**. My 1st contest in 65 years of operating. Had a ball. **Bob, W6UMP**. Had to QRT at noon. fun morning! **Jim, WA6GER**. Thanks for contest. My first and I had a great time. First time I've called CQ QRP and got an answer. **Rob, AB6NZ**. Mother nature threw me an April Fools joke. 9 AM had snow. Hoping it would warm up, almost hit 40 degrees. **Jim, WA0RPI**. Wind picked up my 15' mast, and isotoron antenna. Portable picnic table started to fold up with me inside. But I'm ok now. Perhaps in need of some refinements. **Eric, KD6ORH**. First QRP contest, thoroughly enjoyed it. Thanks NorCal. **Jerry, KD4PUP**. Weather conditions in Florida not too good for field. Perhaps next contest I can make it to the field. Thanks for great contest. **Dave, W0CH**. the peak we operated from was accessible only by foot, approximately 5200 feet. 70 degrees and partly cloudy. **El Paso ARC, W5ES (Andrew, AB5WB) Sugarloaf Mountain Expedition.** I was bound and determined to get out into the field. I made it and I had a ball. Excellent opportunity to field test home brew gear. Can't wait for next QRP Field event. **Craig, WB3GCK**. 40 meters using 2 rigs, NC40A and QRP Plus. **Kent, KK6IU (Mt. Bullion Expedition)**. Had contest gone on another couple of hours, there would have been 200 more potential contacts (75M SSB), evening BC nets. **Derry, VE7QK**. It was still wintertime above timberline in New Mexico. Wind blew entire time and cold (41 degrees), beat

us. About 1600Z retreated to warmer ground. Contest was fun, had a great time **Paul, NA5N and Doug, AB5WT, Mt. Baldy Expedition.** Location - Point North Park, Richardson, Texas. **North Texas QRP Club, Smitty, NA5K, Baity, W2LQ, Bud, K5JHS, Karry, N5OSG, & Bill, K5JHP**. Location was on the Edwards AFB Desert Test Range. **Jim, KG6VI.** Had fun, hope to get in more next year. **D.A. Michael, W3TS**. Operated from Saguaro Lake Park, AZ. Conditions were tough! **David, AF5U/7.** Operated only a couple of hours (at a retreat). Had great fun! **Dave, WA4NID.** N6KR and I operated out of a motorhome, grid square CM87UK. I look forward to the next QRP to the Field. **Wes, WA2CRQ/6.** How about Q's x sections, 1 point qso is no fun. Looking forward to next one. **Dave, K2SJB.** Suggest contest run later into evening. **Bruce, VE7ZM**

QRP to the Field

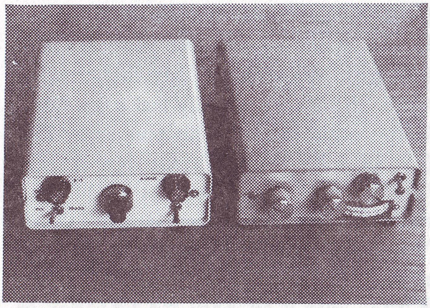
by Floyd Carter, K6BSU
2029 Crist Drive
Los Altos, CA 94022

Individual Contest Results 1 April 1995: 1600Z to 2400Z. All contacts claimed were performed on 40 Meter CW, Single Operator. The total operating time was about 2 1/2 hours because ofanother committment during the day.

Station: 40 meter homebrew CW transceiver of my own design, with a separate homebrew antenna tuner. Power output = 3 watts. The transceiver operates from 10 self contained AA Nicad cells, which ran down at about 2300Z. The remainder of the contest I used a 12 volt Gell Cell. The antenna was a temporary 66' end fed Zepp at 15 ft. Fed with 33' of TV twin lead.

Site: Had to set up in my back yard, because I had to be away from 9 AM til 2:30PM.

Score: 22 qsos on 40M CW x 5 (under 5 watts) x 3 (field operations) x 1.5 (homebrew) = 495
72, Floyd

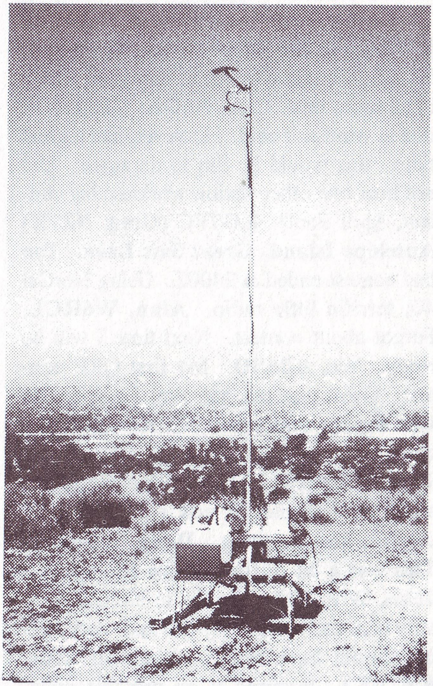


HB Transceiver and tuner by K6BSU

QRP to the Field

by Eric Bikales, KD6ORH
10188 La Canada Way
Shadow Hills, CA 91040

I set my portable station up ontop of a large hill about a quarter mile from my



KD6ORH's Portable Setup

house. Quite a few hills around my neighborhood are undeveloped and used only for horseback riding. anyway, I had a clear shot in all directions and only had a couple of near catastrophies, like when the wind picked up my 15 foot mast and antenna, and my portable picnic table started to fold up with me inside it. But I'm ok now.

I used an MFJ 9020 (5 watts on 20 meters only) operating on Nicads and an Isotron 20 meter antenna up on a 15 foot mast (stuck through the umbrella hole of the plastic picnic table - a system with a lot of possibilities but perhaps in need of some refinement.

My score:

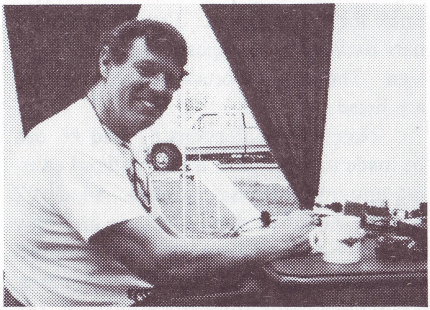
23 Qso's x 5 x 3 = 345 points.

72, Eric

QRP to the Field

by JC Smith, KC6EIJ
1249 Dewing Lane
Walnut Creek, CA 94595

Great contest! I really had fun. got a late start, but the hottest action seemed to be in the afternoon anyway. The morning was highlighted by a bit of ragchewing in with scoring a few points.



JC Smith Operates QRP to the Field

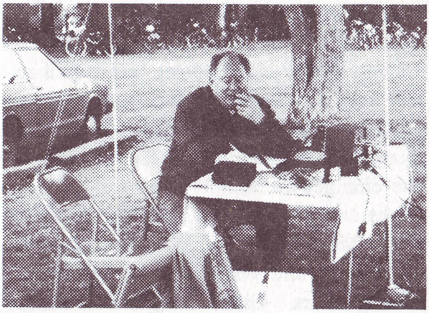
I set up in a tent in my yard and installed my "N6YQD Lite Gear" portable dipole (see Terry's article in Sept. '94 QRPp) between two nearby trees. Power was by gel cell, charged by the sun. I'm sure I didn't need to charge it for an eight hour contest using a NorCal 40, but I thought I would use my memory keyer, and it draws more power than the rig.

This was my first QRP contest, actually my first contest of any kind except for Field Day. I guess I had visions of hot and heavy action. I ended up unhooking the keyer and just using the Oak Hills unit I built into my NC40. It has a much more pleasant sound (different weighting I guess) and I'm more used to it. Paddles were built from the Kent Engineers kit, so if you count kits, I was 100% homebrew. Even the solar charger, power monitor and distribution box were home made.

All of my operations were between 7.030 - 7.040, CW of course. Since I couldn't get the NC40 upto 5W, I turned it down to 1W for the extra points. Made 37 contacts, so that would be 370 qso points. Field location andhomebrew would be x 3 andx 1.5 so: 370 x 3 x 1.5 = 1665 points. One band, one mode.

I can hardly wait for the next one. May even go on a real campoing trip next time.

72, JC Smith, KC6EIJ



Roy Gregson, W6EMT making a contact in the 1995 QRP to the Field Contest.

NorCal would like to thank Bob Farnworth WU7F for all of his work in making the QRP to the Field such a success in its inaugaral year. We will announce the date and times of the 1996 contest in the March issue of QRPp. Thanks again Bob from Doug, Jim, and all of the NorCal members. 72

The New Sierra

Wayne Burdick, N6KR
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Belmont, CA 94002

One year has passed since I completed the design of the Sierra, NorCal's multi-band transceiver project. Jim Cates, Doug Hendricks and Bob Dyer worked hard to get the parts kitted and rigs shipped, and by the end of 1994 over 100 Sierra kits were in the hands of club members. Now it's nearing the end of 1995, and once again I'm completing a design cycle. But this time it was a bit easier: all I had to do was revise the Sierra, not start from scratch!

The big news is that the Sierra will get to crawl out of the ooze and sprout real legs: thanks to new entrepreneur Bob Dyer, it has become the third product in Wilderness Radio's line of QRP gear. In fact, there should be spiffy two-tone blue Sierras en route to points world-wide by the time you read this.

More news, nearly as big is that the Sierra made it to the cover of the 1996 ARRL Handbook! My construction article on the Sierra appears inside. The League's acceptance of the article acknowledges the success of our club project, and it will really help put NorCal on the map!

In this article, I'll explain what changes I've made to the design. Some of the changes are simply the result of new tricks and ideas I've picked up, aided by Dave Meacham, W6EMD, Eric Swartz, WA6HHQ, and Walt Thomas, WA4KAC, among others. Other changes were necessary to elevate what was a good club project design to commercial quality. But the Sierra is still a QRP club project at heart—a compact rig with plug-in band modules that will run all weekend on AA cells!

Caveat: This article was written in October and some component values may have changed by the time you read it. If you're planning to make some of the modifications and would like to order a copy of the new manual (which will have the latest updates) call Bob Dyer (415-494-3806). Or write to Wilderness Radio, P.O. Box 734, Los Altos, CA 94023-0734. If you have technical questions, contact me at 415-592-2700 or 1432 6th Avenue, Belmont, CA 94002.

Physical Changes

The new Sierra will be the same size as the old, but will look and feel a bit different. Like the NorCal 40A, it will be professionally painted and silk-screened. More important, the chassis will be much more rigid, thanks to L-brackets that hold the front and back panels to the bottom cover. These L-brackets are welded to the panels, and secured to the bottom cover with four screws. Top cover removal is not affected; the usual plastic latches are still there.

Another physical change is the use of U-shaped covers for the band modules. Fabricated out of durable plastic, this cover will make it easier to insert and remove the modules, protect the back of the board, and give the module a neater appearance. The cover can be used with old band modules, too.

Transmitter Changes

I cut some corners in the original transmitter design to keep the cost low—appropriate for a club project. I've "put the corners back in," so to speak, with the re-design. The most important of these changes are listed below.

Note: Modifications #1 and #6 can be made to an original Sierra without causing any unwanted side effects. Mods #2 and #3 should be done together, and only after #1 has been completed and its effect measured. #4 may be useful in rare cases. #5 triggers many component changes and is included only for reference.

1. Improved VFO and crystal oscillator drive into pre-mixer

One of the biggest challenges in a multiband design is obtaining consistent signal levels at all stages and on all bands. This begins with the signals injected into

the pre-mixer , U7 (refer fig. 1). If these levels are too high, the pre-mix output will have high spurious signal content; if too low, transmit output power will be reduced. As it turns out, the injection levels can be increased somewhat from their original levels, resulting in higher, flatter pre-mix output from 160 through 10 meters.

To increase the VFO injection level without altering the VFO low-pass filter (R22/C61), I simply changed Q3 to a J309. (In fact all of the JFETs in the new design are J309s, which have much higher and more consistent transconductance than MPF102s or 2N4416.) To improve crystal oscillator injection, which had been on the low side with some crystals, I added R9 (fig. 1). This trick is described by the NE602 data sheet as a way to improve oscillator starting when the device is used at VHF, but it helps even at HF.

2. Improved pre-mix buffer stability on higher bands

Some Sierra builders found that on 15 meters and above the transmitter output would break into oscillation at certain power levels. I traced this to two components: the inductor in the drain lead of Q8 (now Q2); and the 47K band-pass filter termination resistor (R23).

Thanks to the increase in U7's output described above, along with the use of another J309 at Q2, I was able to reduce the value of R23 by a factor of 10 and reconfigure Q2 as a unity-gain source follower. The stiffer termination makes the filter easier to align and less susceptible to feedback from the transmitter output. Making Q2 a source follower eliminates RFC2 and the associated voltage gain that peaked at around 20MHz, which is no longer necessary. (And hey, it's one less toroid!)

Note: C5 (RX mixer injection cap) increases to .001uF in the new circuit, and C63 increases to 10pF.

3. Increased output from transmit buffer

The original transmit band-pass filter termination (R11) was quite high—12K—to compensate for minimal drive on the higher bands. With a new transmit buffer circuit in place (figure 2), I was able to eliminate C37 and decrease R11 to a stiffer termination of 5.1K. The logic for this is similar to that for reducing R23 to 5.1K in the pre-mix filter. Also note that this allowed C31 to be increased to 10pF.

The new transmit buffer circuit is a significant improvement. In the earlier, simpler design, there was nothing but a 390-ohm resistor from Q5 source to ground. This resistor was used to establish the drain-source current for Q5, but this in turn allowed the base bias voltage of Q6 to vary somewhat based on the particular device used at Q5. In the new circuit, the two 1N914 diodes in the source circuit establish a fixed bias level of about 1.4V for Q6. With the bias stabilized, the performance of Q6 is more consistent, and output is more constant across all bands.

Other changes made in conjunction with the new buffer circuit include the addition of C67 and C79, an increase in the size of C51, and the removal of 4 turns from the primary of the driver/PA transformer. The new 8 turn : 3 turn winding reduces the negative undershoot at the base of the PA transistor that we had seen on some bands. With 12 turns, the voltage developed at the driver collector can be excessive, leading to an undershoot of as much as high as -4.2 volts, which is too close to the Vbe reverse-breakdown voltage for comfort.

4. Improved driver keying

In the original driver emitter circuit, D10 was connected directly to R14. This meant that the device used for keying became part of the resistance in Q6's emitter circuit, and also the drop across D10 reduced the emitter bias voltage. Some keyers and keyboards have, believe it or not (I found this out the hard way) a resistor in series with the keyed output. In this case the keying

device itself could reduce the maximum output power available from the driver!

To completely isolate the keying device from Q6, I added Q8 and Q9. Together, these transistors form a non-inverting buffer with an open-drain output. When the key is pressed, Q9 turns off, allowing R12A to completely turn on Q8. Q8's drain-source circuit looks like around a 1-ohm resistor in this condition, so it has a negligible effect on Q6's emitter circuit. As in the old circuit, releasing the key allows C51 to charge, producing a smooth decay in output.

While the new driver keying circuit is more complex, it actually results in a net gain of only one component on the Sierra's PC board. This is due to the use of a 47K SIP (single-inline-package) at R12, which supplies the two resistors needed for Q9 and Q10 but also replaces two resistors from the original design (R9 and R10).

5. More consistent transmit monitoring level

On some bands, and at some settings of the drive level and RF Gain controls, the transmit monitor volume was too low. To solve this problem, I bit the bullet and added a true sidetone oscillator in lieu of direct TX monitoring, using the second half of the LM358 op-amp in the receiver. The sidetone oscillator is a standard square-wave oscillator, but the output is heavily rolled off so that the tone is near sinusoidal. The sidetone volume can now be adjusted with a trimmer, and the standard pitch of about 650 Hz can easily be raised or lowered with one capacitor change.

6. Misc. transmitter changes

The transmit 4.915MHz oscillator inductor, L2, has been increased to 18uH to allow the TX offset to be set to the middle of the receive crystal filter bandpass. Also, a few components in the bandpass and low-pass filters will change. See Dave Meacham's recent QRPp article (September 1995) for ideas, although final values may be different due to component availability constraints.

Receiver Changes

Receiver changes of interest are described below. The changes are minor and are not recommended for use in the original Sierra. Refer to the new Sierra manual for circuit details.

1. AGC threshold adjustment

Following the lead of the NorCal 40A, the AGC threshold is now adjustable, from no AGC action at all to complete silence. To make the AGC adjustable, I switched to an AC-coupled detector arrangement and used a potentiometer to provide a variable detector bias voltage.

2. Dual JFET mute circuit

Because the transmitter now uses a sidetone oscillator, I had to change the way the receiver gets muted. Muting used to occur in the I.F. Now, muting is handled by a pair of JFETs between the product detector and A.F. amp, as in the NorCal 40A. This also accommodates the MUTE line of the KC1 keyer/counter. (Refer to the KC1 manual for additional details on this modification.)

3. I.F. Amp output inductor swamping

I added a 1.8K resistor across RFC1 (now L2). This eliminated a tendency for the AF amp to "ring" a bit at very high volume settings. I also added two supply isolation resistors, one for the RX mixer and one for the I.F. amp.

Manual Changes

The new Sierra manual is nearly a complete re-write. This was necessary to give it a more "Heathkit" feel—instructions so complete that nearly anyone can successfully build and align the rig.

Among other things, I renumbered all of the inductors according to their physical characteristics. All of the prewound, solenoidal chokes now have "RFC" designators, and all of the toroids have "L" designators. In previous designs I've used "RFC" for inductors functioning as chokes even if actually wound as toroids, and "L" for inductors functioning as resonant ele

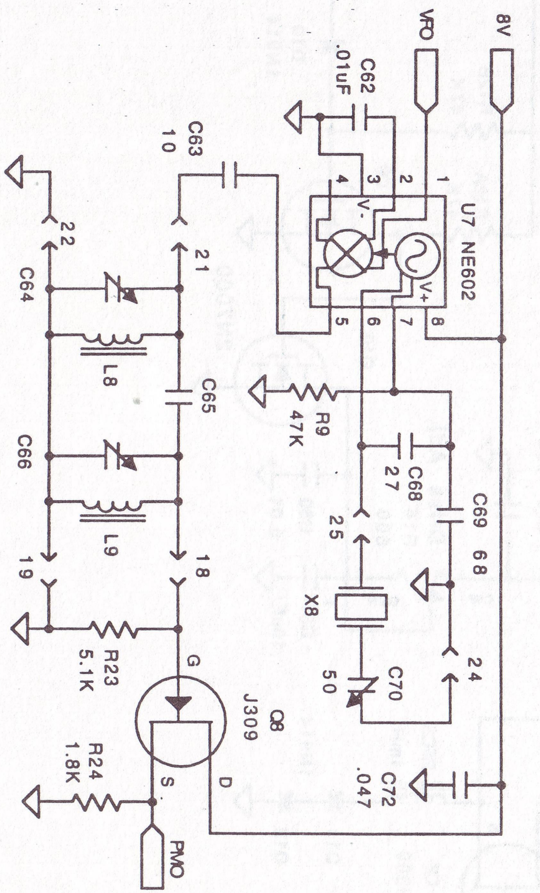
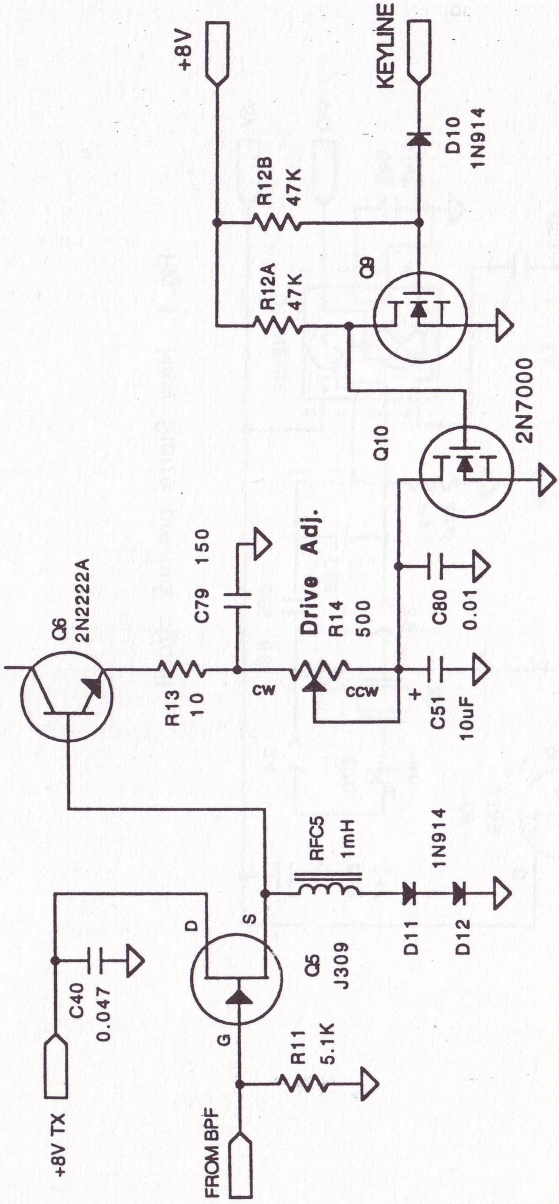


Fig. 1. New Sierra pre-mix circuit.

Fig. 2. New Sierra transmit buffer and driver circuit.



ments even if the were actually small solenoidal chokes. While the old method is more accurate from an electrical standpoint, it is confusing for some first-time builders.

Conclusion

It has been a challenge getting the Sierra up to the point where it's easier to build and align. NorCal members deserve much of the credit, since they supplied the feedback and field testing that pointed out the problems and opportunities. Thanks again!

NC40 to NC30 Conversion

by Ed Burke, KI7KW
28 Del Prado
Lake Oswego, OR 97035

Since I have been delighted with the performance of my Norcal40 and 40A (I have built one of each) I decided a while ago to make a Norcal30. It works just fine and I thought that I would share the changes with other enthusiasts.

The list of components refers to the schematic for the Norcal40A as it was issued by Norcal. I am not sure that Wilderness Radio has continued the same numbering system, so check with Bob Dyer if you have the latest version from them. The parts shown below are what I actually used in my 30 meter rig; you can probably make substitutions for most without any problems; for instance, where I used a silver mica cap, you can substitute a ceramic capacitor.

L1 21 turns, #26awg on FT37-67 toroid (note material).
T1 1 turn primary, 21 turns secondary, #26awg on FT37-67 toroid (note material).
C4 2.5pF (use two 5pF caps in series if 2.5pF is unavailable).
T3 20 turn primary, 4 turn secondary, #26awg on FT37-61 toroid.
C6 15pF.
C9, 10, 11, 12, 13 390pF, silver mica (this gives a 500 Hz filter bandwidth).
L4 12 turns, #24awg on FT37-61 toroid.
C14 47pF
C38 51pF, silver mica.
L6 24 turns, #26awg on T37-2 toroid.
L9 62 turns, #28awg on T68-7 toroid. You may need to adjust this slightly.
C49 47pF.
Q1 MPSH10 NPN RF transistor (optional; it probably helps a little).
X1, X2, X3, X4, X5, X6 Digikey CTX 082 crystals. Four must be matched using a simple test oscillator to 30 Hz.
L7, L8 16 turns, #24awg on T37-2 toroid.
C45, C47 200pF silver mica. 300 volt rating would be desirable.
C46 470pF silver mica, 300v also.
C31 10pF.
C35 68pF.
C18 200pF, silver mica.

This is the list of new component values. I'm surprised that it is so long. I also did the transformer output matching mod per QRPp June, 1994, as well as changing the output transistor to an MRF237 (adding a robust heat sink to that part). The result is a very nice signal just shy of 5 Watts.

My impression is that the received audio is a little "weaker" than the Norcal40A, but I'm not sure how much of that is due to the overall quieter band conditions on 30 Meters. Theoretically, there is some loss in gain due to operating closer to the gain-bandwidth product for the NE602, but the Norcal 30 is still eminently usable; I've had DX contacts with New Zealand with it, for instance.

Best of luck, 73's and enjoy!
Ed Burke KI7KW

The Green Mountain Transceiver

by Dave Benson, NN1G
80 East Robbins Ave.
Newington, CT 06111

This article describes a single-board transceiver design intended for use on any one of the HF bands. This design is merged from both the "40-40" and the earlier NN1G Mark III ('95 ARRL Handbook)

transceivers. This article describes the 20 Meter version, but operation on other bands is largely identical.

First, though, a bit of background information seems fitting. I've been contending with inquiries about the XX-40s, 30-40s, 40/30s and so on, and it seemed high time to vest the latest project with a name less subject to creative interpretation! In continuing the tradition of naming rigs after high places, I've designated this project in honor of the mountain range which runs the entire length of Vermont.

The key design feature is a heterodyne local oscillator. Although theextra complexity isn't necessary for a low-band design, it really facilitates operation on the high bands A Colpitts oscillator running in the 4.5 Mhz region is mixed with a crystal-controlled conversion oscillator and then bandpass-filtered to yield the desired 22 Mhz injection frequency. Once again, a varicap is used for tuning, this time to provide coverage of 100Khz. This increased range necessitated some form of varicap temperature stabilization, which is provided by the 1N4148 diode in the bias tuning circuitry. The remainder of the LO components were chosen for good thermal stability. The 20M version exhibited a cold-start drift of only about 10 Hzwith the tuning pot at mid-range! [In case you're curious, I considered using a 1/2-DIP CMOS oscillator IC for the conversion oscillator but cost, availability and relative spectral purity all weighed in against this scheme. This would have enabled 6M operation without requiring yet another adjustment (for overtone operation).

This design also has a number of other upgrades, so let's take a look:

* **Packaging-** The printed-circuit board version of this transceiver is a double-sided and masked affair measuring 3.5" x 5". As such, there are no on-board jumpers needed to complete the wiring. This time around, all controls and other external connections with the exception of the coax connect using 0.100" header strips and wire assemblies (provided pre-assembled in the kit version). Why? It looks much neater and oh by the way-it's much easier to troubleshoot if the transceiver disassembles easily.

* **Better Crystal filtering-** A glance at the schematic reveals that the IF filter's been upgraded to the 4-crystal version. The IF frequency is 8.00Mhz, which will support operation even on 6M with adequate image rejection.Adjacent-sideband rejection was measured at -40 dB, a noticeable improvement over the 30-40 performance. Filter loss is 5dB, an improvement over the lossy 30-40 performance, and bandwidth is approximately 800 Hz . Receiver MDS is approximately -125 dBm.

* **Improved front-end filtering.** The receiver front end circuitry has additional filtering to improve image rejection. The "30-40" in particular was marginal in this regard. There's a double-tuned circuit this time, and the T-R switch design reverts to the W7EL series L-C to provide additional bandpass filtering. I can hear you saying- "I hate winding toroids!- Why didn't you use IF transformers like in the NN1G design?"] I didn't want the filter design constrained by the IF transformer characteristics. By using toroids, there's more leeway in setting filter values to suit each band. As I came down to the wire for publication, my signal generator is out for calibration, so I'm currently unable to provide measured values for imagerejection.

* **RIT-** You asked for it, you got it! Although I rarely use a RIT control, it's a must for many folks. The circuit is a derivative of the RIT upgradewhich appeared in the pages of 72 a while back. The polarity on the On/Offcontrol has been reversed with respect to that earlier version to allow the use of a control pot with an integral On/Off switch (isn't hindsight wonderful?). If you're using the printed-circuit board version of this design, the RIT pot/switch are connected through a 4-pin

header. If you don't plan to use the RIT feature, this header may be left unused and RIT will be inactivated.

* **TX drive-** The TX drive chain has been beefed up to provide more gain and improved stability. The transmit bandpass filter has a MMIC imbedded in it(see the July '95 issue of 72). In addition to the improved gain, the placement of the gain block in this location loads the filter, which aids stability by keeping the impedances reasonable. This pays off in a tuneup procedure free from unwanted anomalies (i.e, jumps in output level and othersigns of instability). Although the use of a MMIC is overkill in this application, they're small- this is a nice way of saying the darned thing fit! In practice, I'm able to adjust the drive to provide output levels ranging from 0.5W to the full rated power.

* **TX power-** Thanks to the improved drive, there's more output power available. You should see 2.5-3 watts on any of the bands, and the output harmonic filter has been designed for this level. For the 20M version, at full power the 2nd harmonic is down 34 dB. Spurious outputs were down about50 dB.

* **The Joy of Big Audio.** The various op amp and LM386 audio finals have been replaced with the 8-pin version of the LM380. Although this device draws a bit more idling current than its little brothers, it's worth it in terms of audio quality, and on a good signal will easily annoy other family members! Idling current on the transceiver as a whole is approximately 35 mA, still a battery-friendly value for the portable crowd. I did tinker with audio-derived AGC but was never happy with the result. I've left this feature off and provided a tie-point (W1) at pin 5 of the IF Amp for those folks determined to experiment with this function.

20-Meter parts values not shown on the schematic are as follows:

C31,33: omit- not used
Q1: MPF102
Q2-Q5: 2N2222A metal
Q6: 2N3906
Q7: 2SC799 or 2N3553
U1,4,6,7: NE602AN
U2: MC1350P
U5: 78L08
U8: MAR-3
U9: CD4066
D1: MV1662
D2-D8: 1N4148L1,
L1: T37-6, 14T (0.59 uH)
L3: T37-6, 26T (2.0 uH)
L4, L5: T37-6, 17T (0.87 uH)
L6,L7: T37-6, 15T (0.68 uH)
L8: FT37-61, 11T (6.8 uH)
L9: T37-6, 11t (0.36 uH)
L10: T37-6, 13t (0.50 uH)
L11: T37-2, 27 turns (3.3 uH)
T1: 10.7 Mhz IF xfrmr (Mouser 42IF123)
T2: FT37-43, 4 turns bifilar.

If you're interested in the kit version of this transceiver, it includes thehigh-quality board, all on-board parts and interconnect assemblies for the external controls. As with the 40-40 series, there's a honest-to-goodness intruction manual. The price is $72 postpaid. The GM-20 and its 30 and 15-meter brothers are currently available. Additional bands will be added shortly as based on popular demand. See you on the high bands!

To order the Green Mountain Transceiver send a check or money order for $72 to: Small Wonder Labs
80 East Robbins Ave.
Newington, CT 06111

Please specify the band that you wish to order.

72, Dave, NN1G

[Note: this article first appeared in "72" the journal of the New England QRP Club. It was updated by Dave and is reprinted with permission from "72". Thank you to Dave and "72" for allowing us to reprint the article. Schematics can be found in the center foldout section. Doug, KI6DS]

The St. Louis Tuner

NorCal is now taking orders for the St. Louis Tuner which will be delivered in the Spring of 1996

The NorCal QRP Club along with the St. Louis QRP Club are pleased to announce that the St. Louis Tuner is now available. The tuner is a T-match, with dual meters for continuous display of forward and reflected power. It contains a SWR bridge that is a combination of the Lewallyn and Stocton circuits. The tuner also has a 10Watt dummy load, balun, and has the following connectors: SO239, BNC, RCA Plug, 5 Way Jack for both incoming and outgoing signals. The capacitors are custom made dual section air variables with a quarter inch shaft. (Not the plastic AM tuning ones used in the prototype.) The front section has 140pF and the back section has 91 pF. Cost of the complete kit, which contains pcboard, all components, wire, Case (matches the Sierra and Cascade), Knobs and switches is $75 US Funds only. Postage is $5 in the US, $10 Canada and $15 DX. California residents please add $5.44 sales tax. California residents send $85.44, all other US residents send $80, Canadian members send $85 and DX members $90, all in US Funds only!!! Make checks or money orders out to: Jim Cates, NOT NorCal or QRPp. We are only kitting 250 of these, so order quickly if you are interested. Send your orders to:

Jim Cates
3241 Eastwood Rd.
Sacramento, CA 95841

Cascades

We have 50 Cascade kits left. The price is $199 plus $5 shipping in the US, $10 to Canada, and $15 to DX addresses. This is absolutely the last of the kits and when they are gone, there will be no more. Send your orders to Jim Cates, 3241 Eastwood Rd., Sacramento, CA 95841. California residents please include $14.43 sales tax. To order a Cascade 20/75M SSB transceiver: Ca. Residents send $218.43, US Residents send $204, Canadian Residents send $209, and DX addresses send $214. All orders must be in US FUNDS only. Kits will be shipped in the spring. Make checks and money orders to Jim Cates, NOT NorCal.

Back Issues of QRPp

Back issues of QRPp are available in bound issues only. Volume I contains the 3 issues from 1993, Volume II contains the 4 issues from 1994, and Volume III has the 4 issues from 1995. Volume I is 140 pages and is $10 plus $2 shipping for US addresses, $5 DX. Volume II is 296 pages and is $15 plus $2 shipping for US addresses, $5 DX. Volume III is 276 pages and is $15 plus $2 shipping for US addresses, $5 DX. If you order all 3 volumes the cost is $40 plus $3 shipping for US addresses, $10 DX. To order send your money to Doug Hendricks, 862 Frank Ave., Dos Palos, CA 93620. Make all checks and money orders out to Doug Hendricks and not to NorCal or QRPp. All prices are for US funds only.

Curtis 8044ABM Keyer Chip and Far Circuits Board Combo

NorCal has made a bulk purchase of the Curtis 8044ABM Keyer Chip and isoffering it with the Far Circuits Board and the Info Sheet for $17.00 postpaid. DX orders add $5 shipping. US Funds only! Make Checks or money orders out to Jim Cates, NOT NorCal. Send your orders to: Jim Cates, WA6GER, 3241 Eastwood Rd., Sacramento, CA 95821.

7.040MHz Crystals

We have located a supply of 7.040MHz crystals in the small HC49 holders. These are on the QRP calling frequency for 40 Meter CW. The price is $3 each, or 4 for $10, postage paid. Make Checks or money orders out to Doug Hendricks, NOT NorCal. Send to: Doug Hendricks, 862 Frank Ave., Dos Palos, CA 93620.

NorCal QRP Club

QRPp is published at Dos Palos, California 4 times per year: March, June, September, and December. Subscription fee is $10 per year for US residents, $15 for Canada, and $20 per year for DX. To join NorCal QRP Club send your name, call, and address to Jim Cates. There is no charge for membership to NorCal QRP Club. To receive QRPp, you must subscribe and pay the fees. Send your money (US Funds ONLY) to:

Jim Cates, WA6GER
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Sacramento, CA 95821

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